Appendix F

Waterway for LNG Marine Traffic Maps

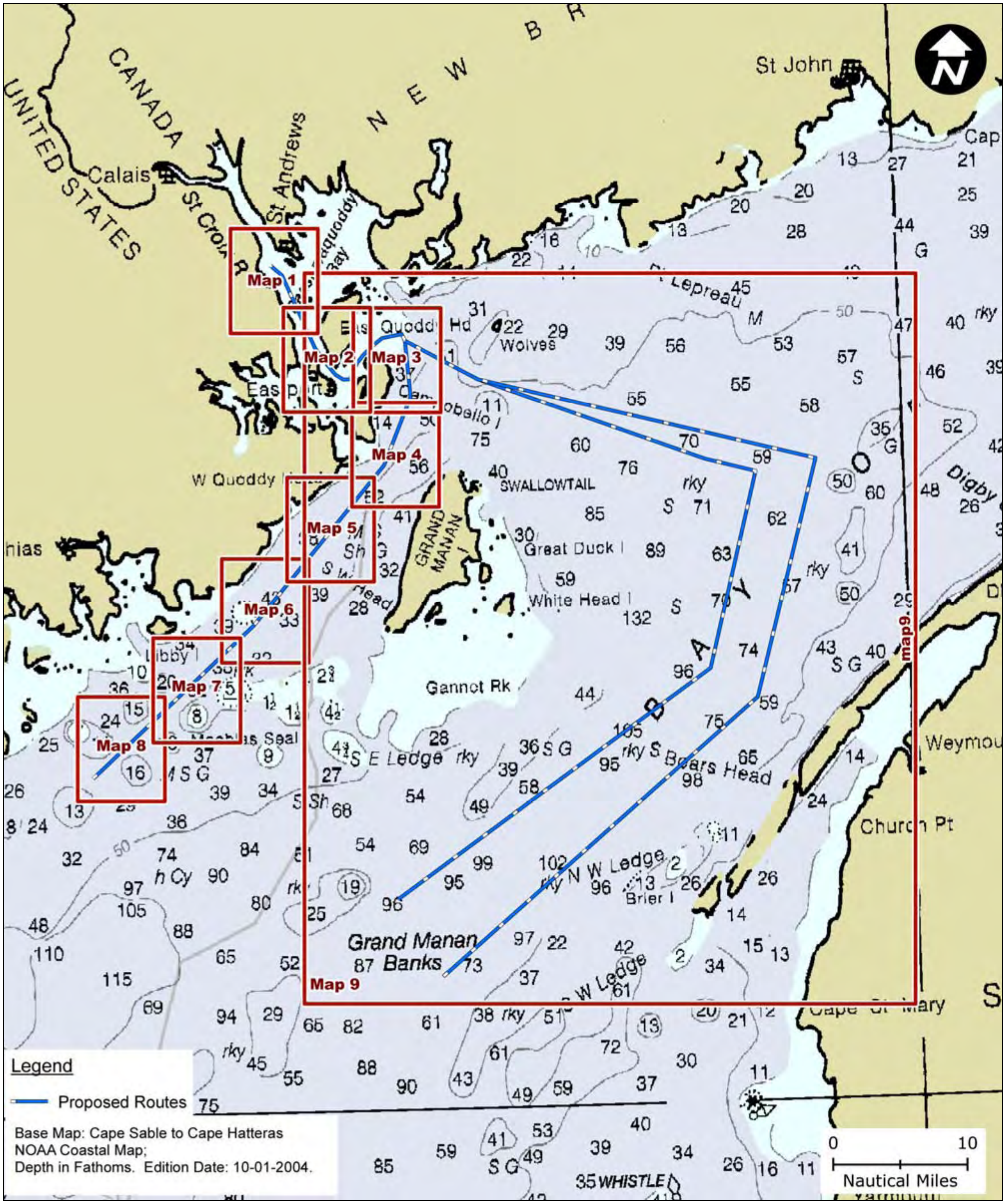

Figure F-1
Downeast LNG Project
Waterway for LNG Marine Traffic – Overview

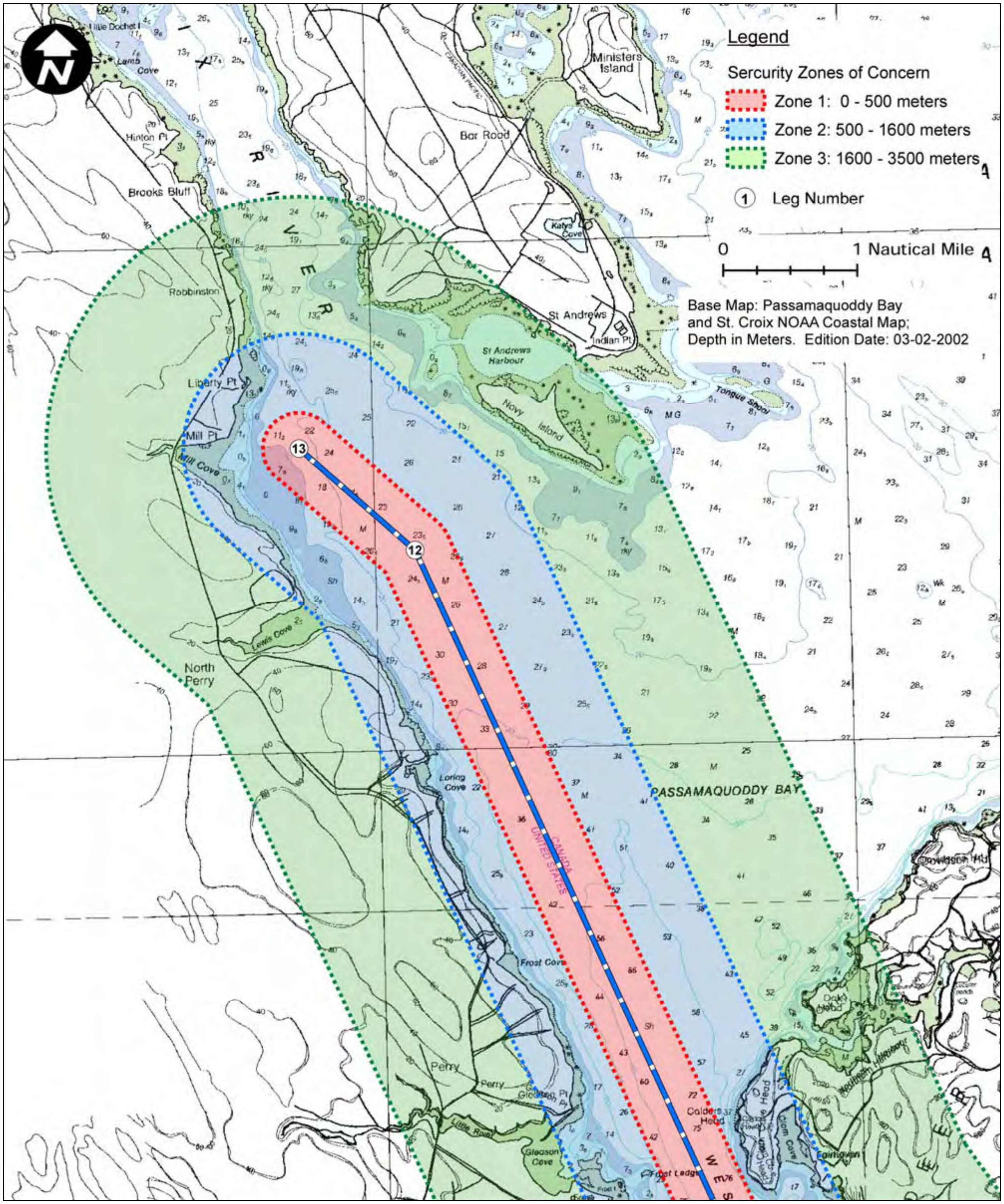

Figure F-2
Downeast LNG Project
Waterway for LNG Marine Traffic: Sheet 1 of 9

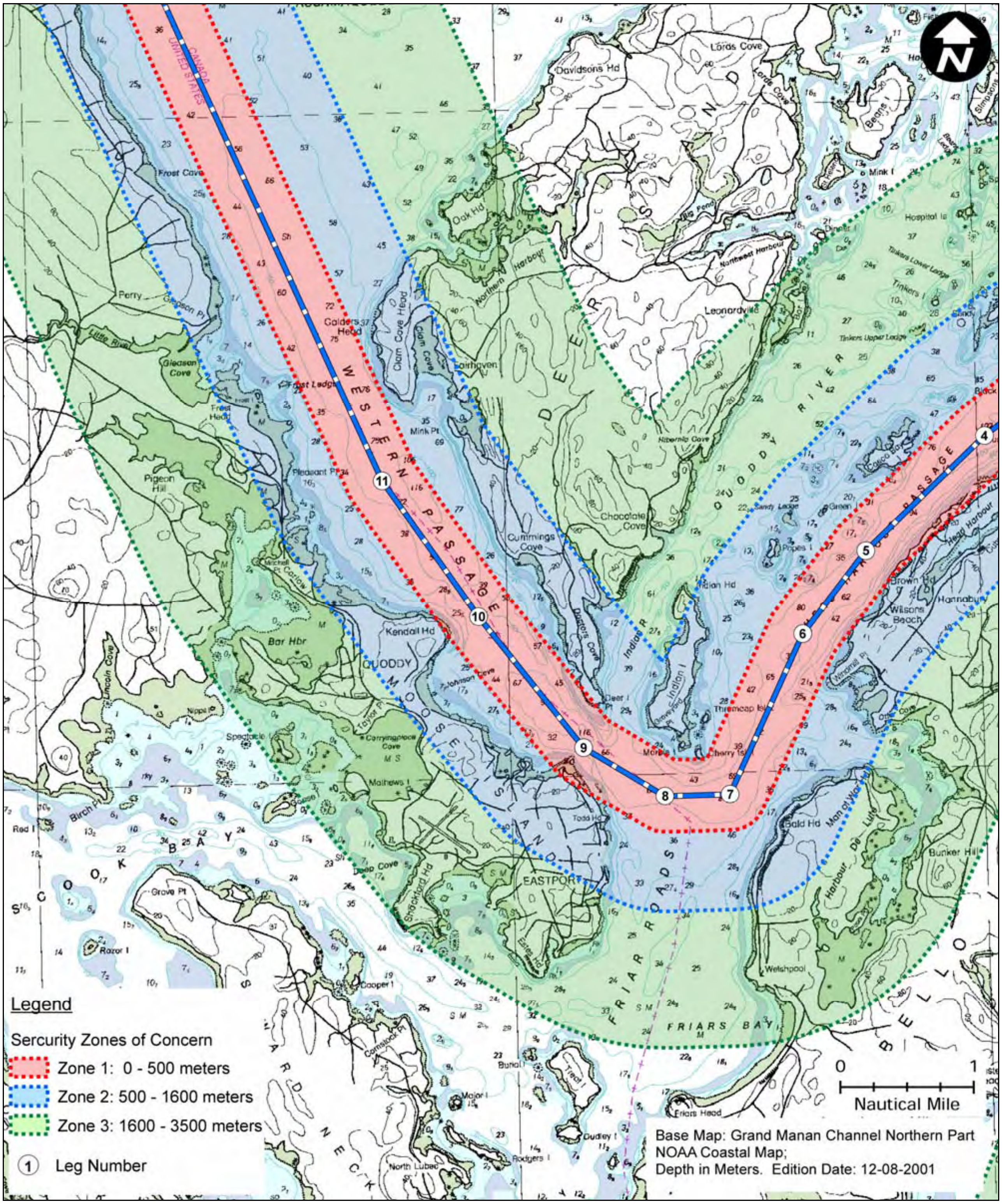

Figure F-3
Downeast LNG Project
Waterway for LNG Marine Traffic: Sheet 2 of 9

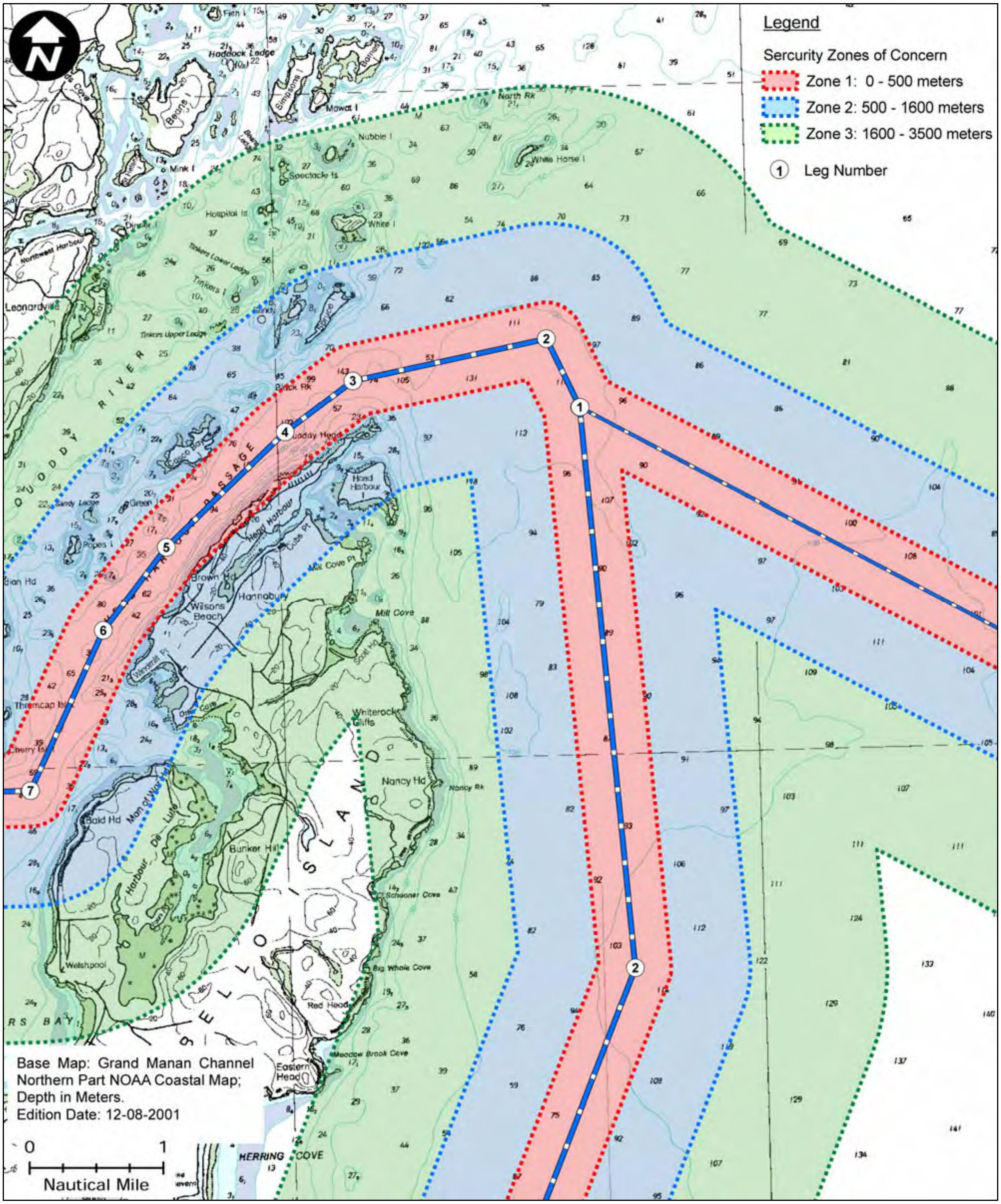

Figure F-4
Downeast LNG Project
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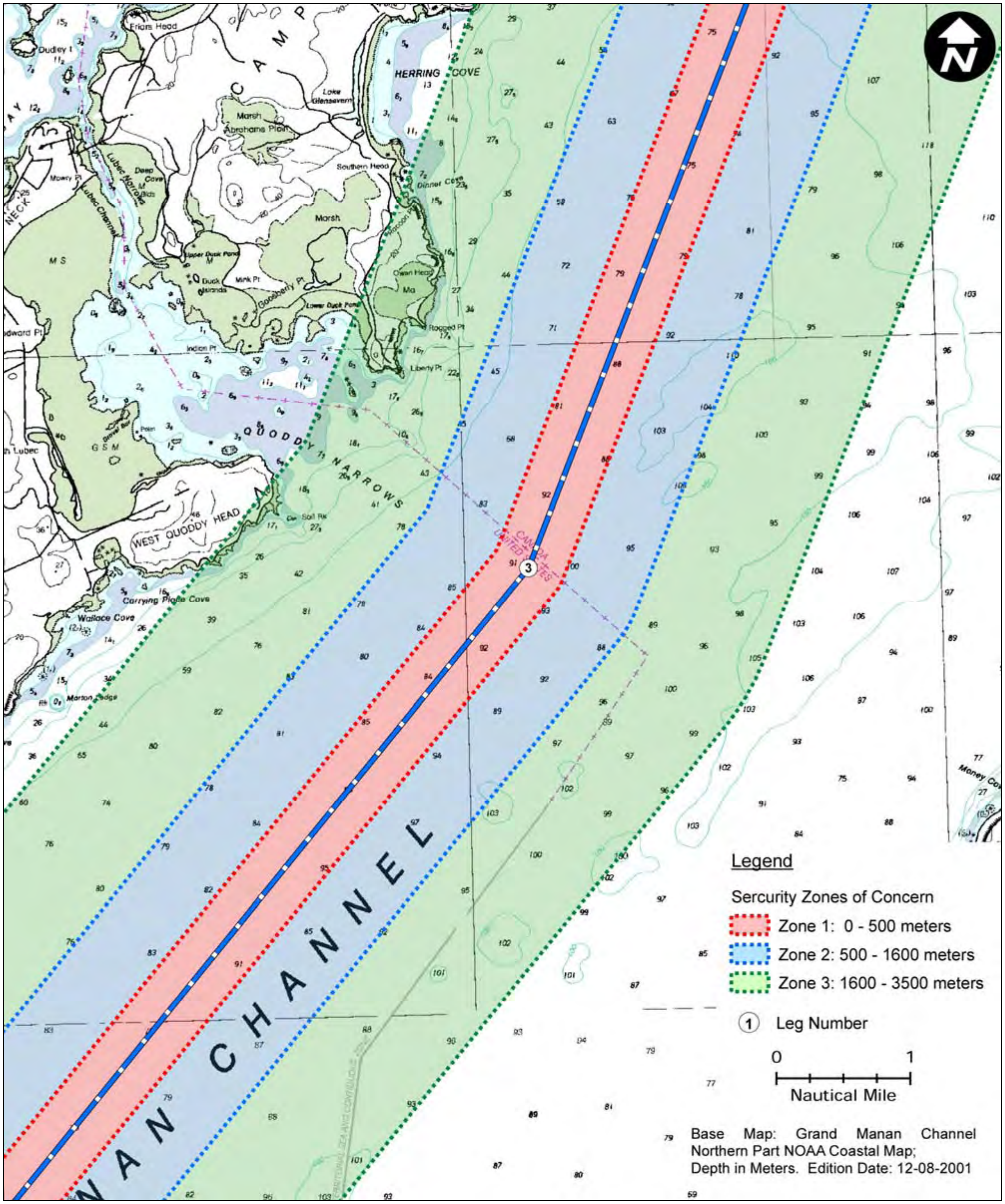

Figure F-5
Downeast LNG Project
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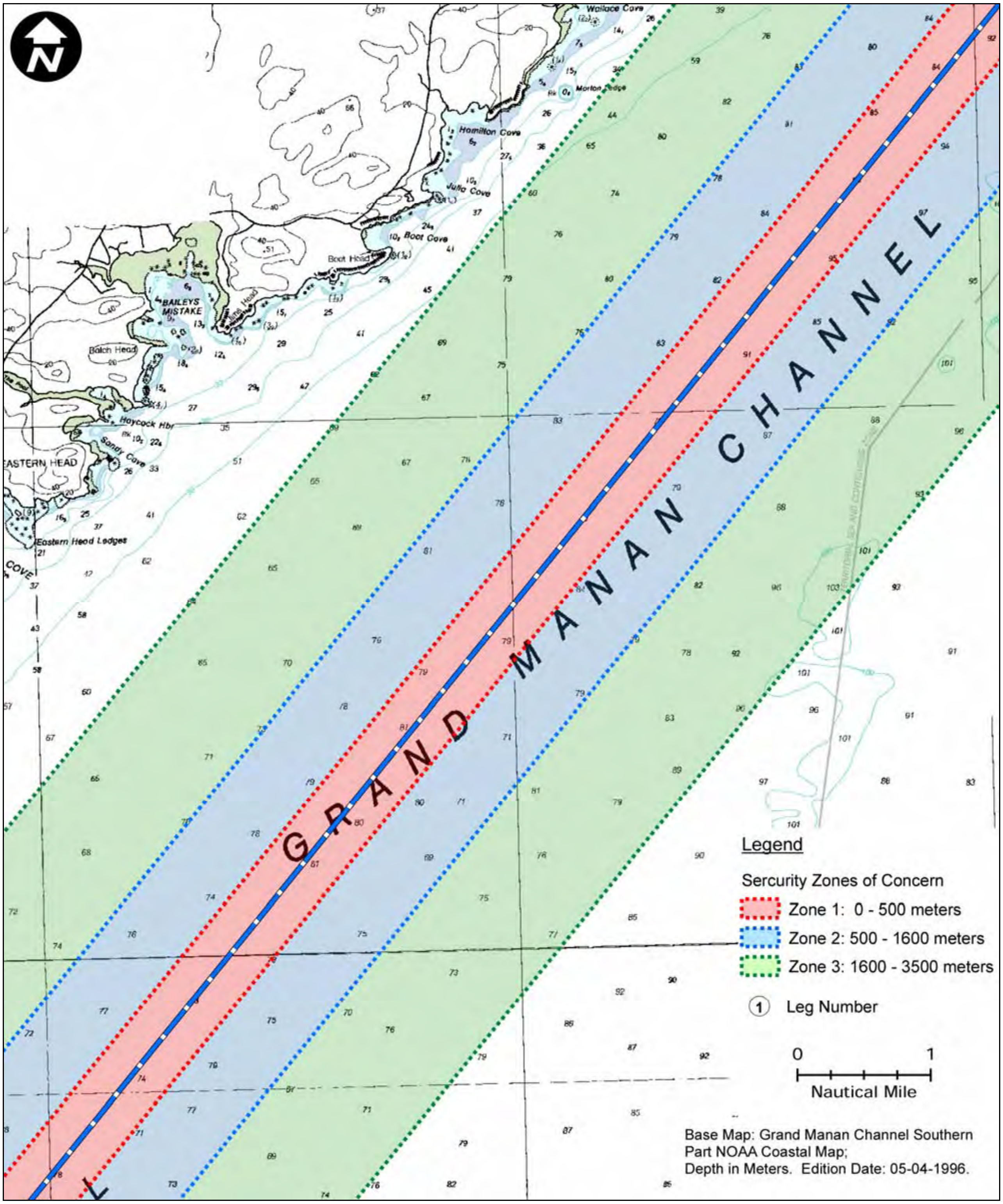

Figure F-6
Downeast LNG Project
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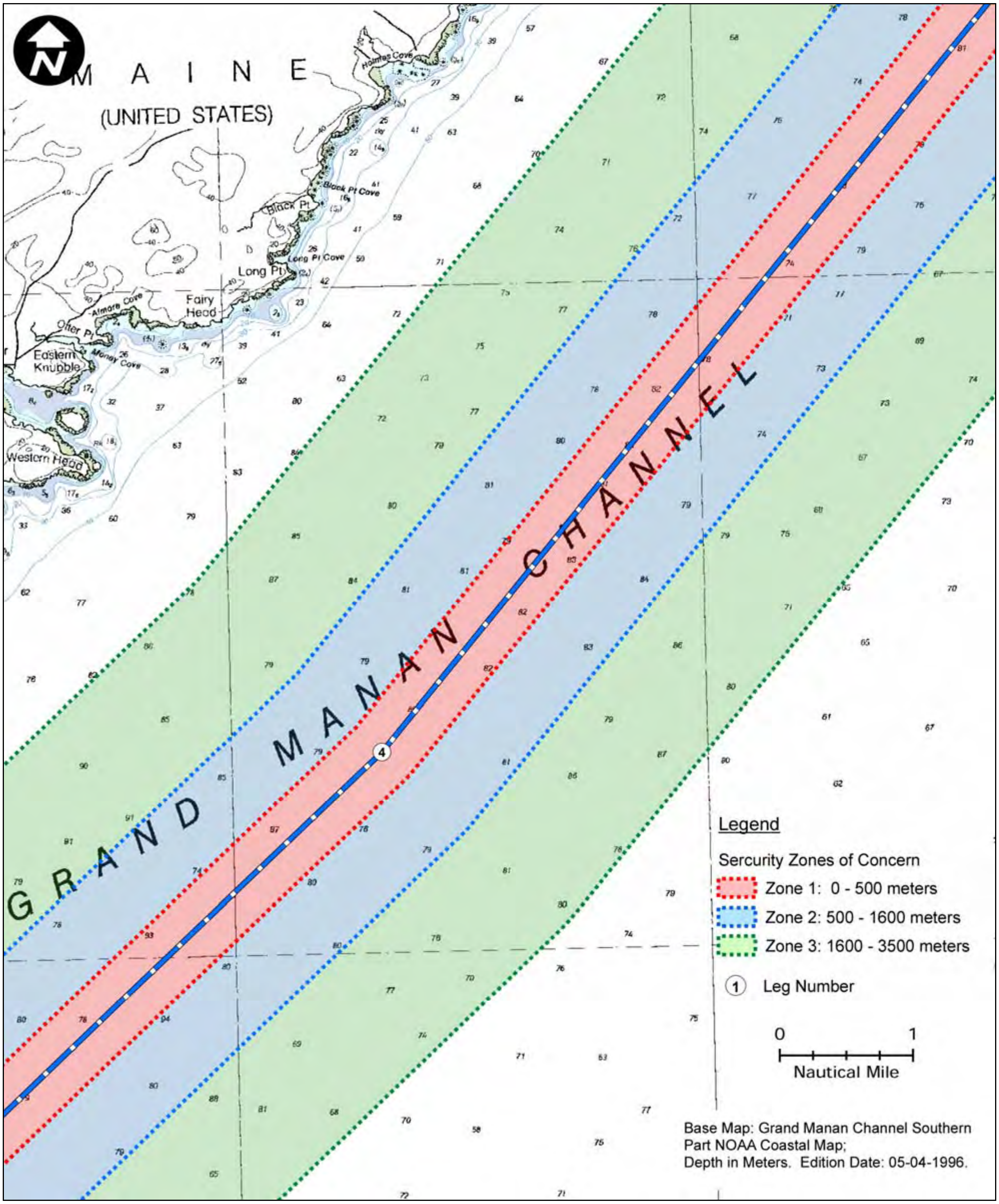

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Downeast LNG Project
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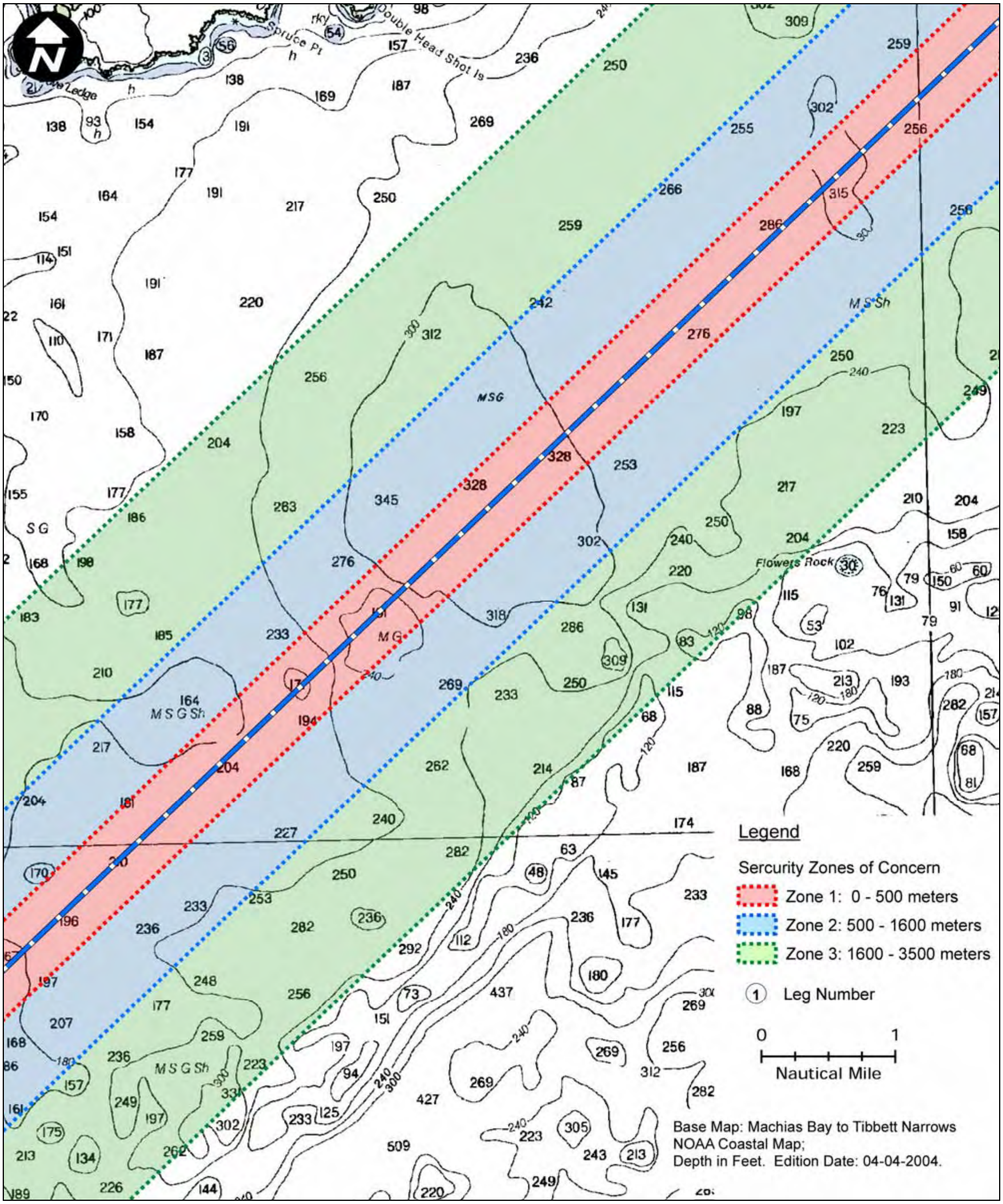
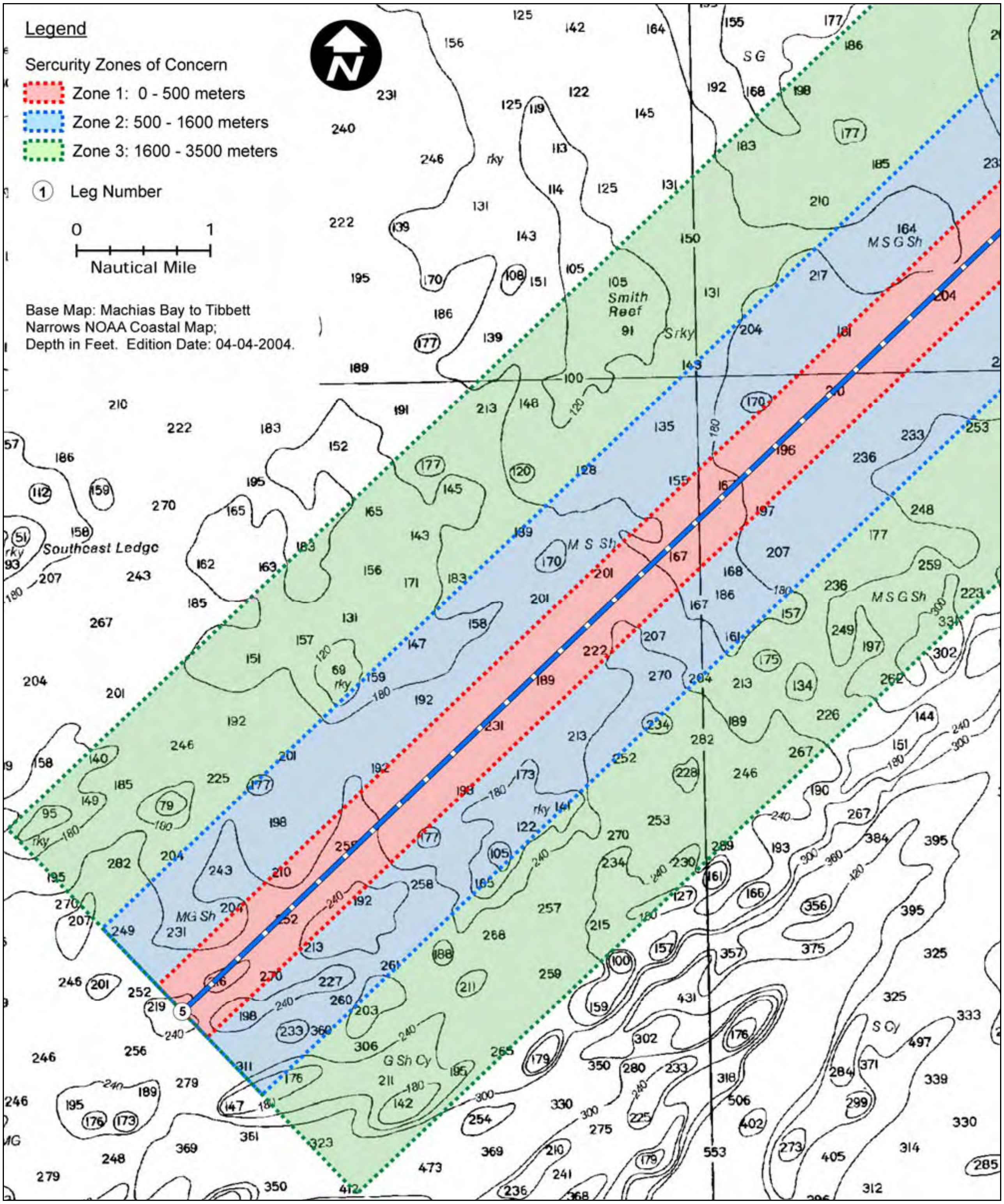


Figure F-8
Downeast LNG Project
Waterway for LNG Marine Traffic: Sheet 7 of 9



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Downeast LNG Project
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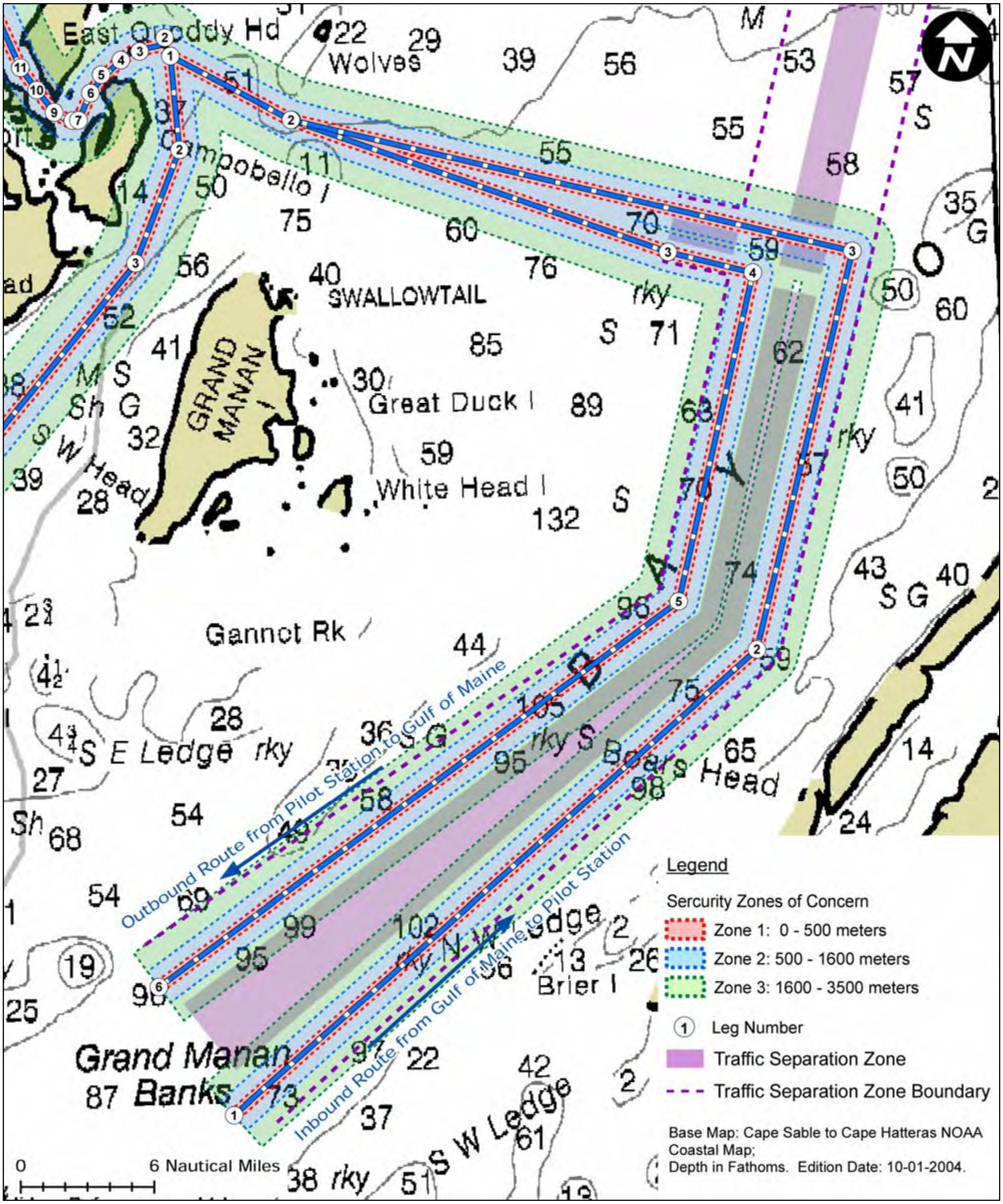

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Downeast LNG Project
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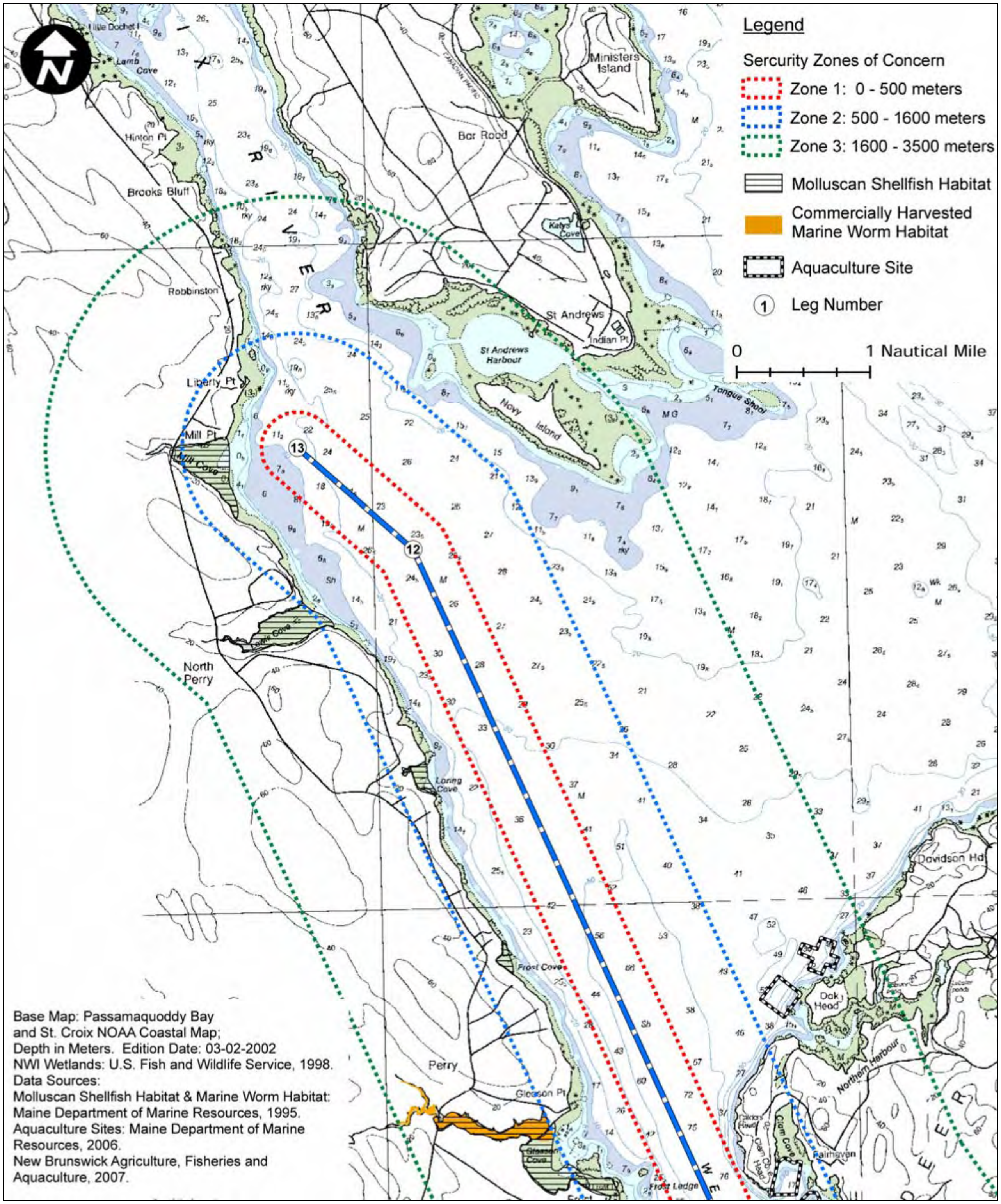
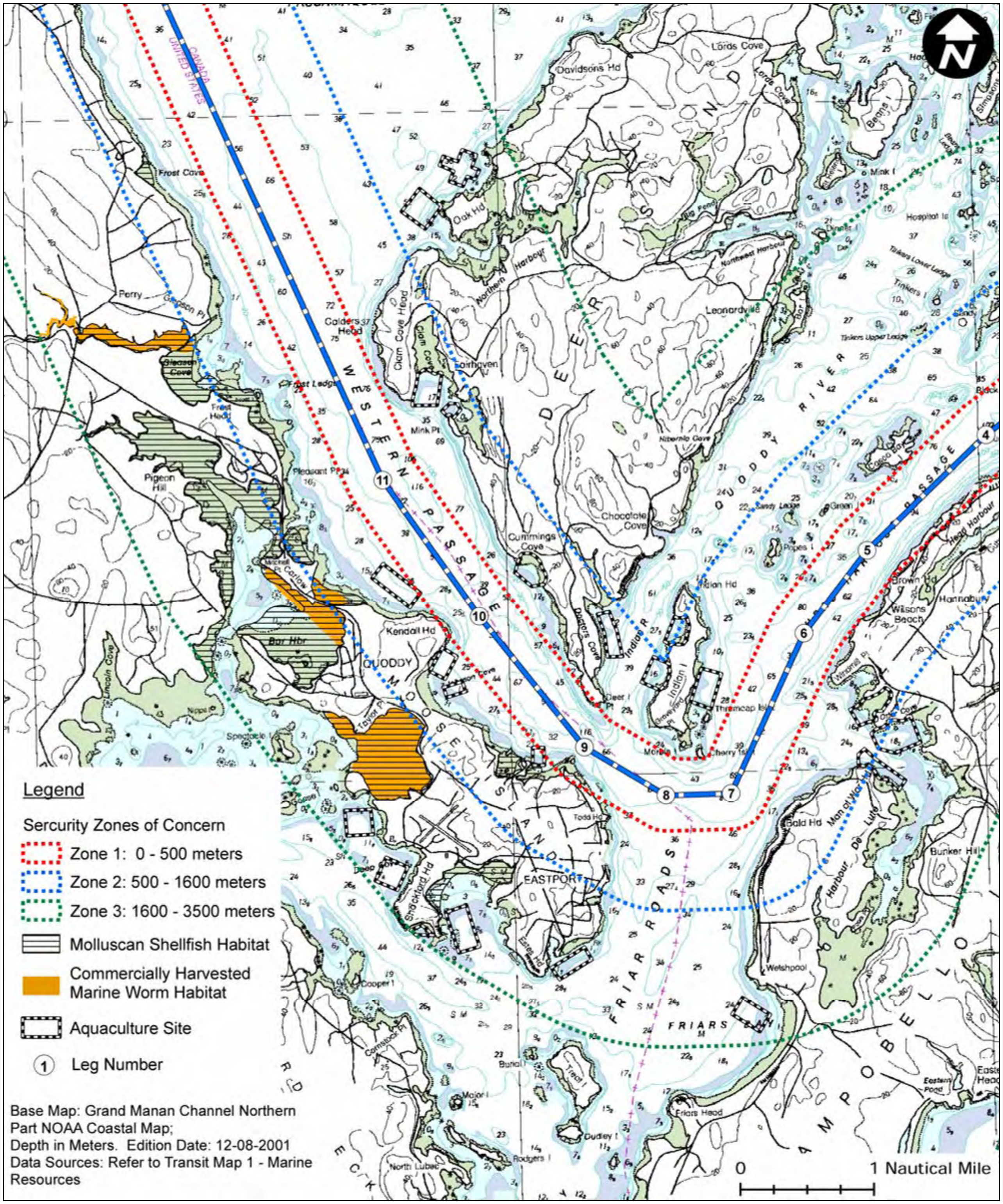


Figure F-11
Downeast LNG Project
Waterway for LNG Marine Traffic – Marine Resources: Sheet 1 of 3



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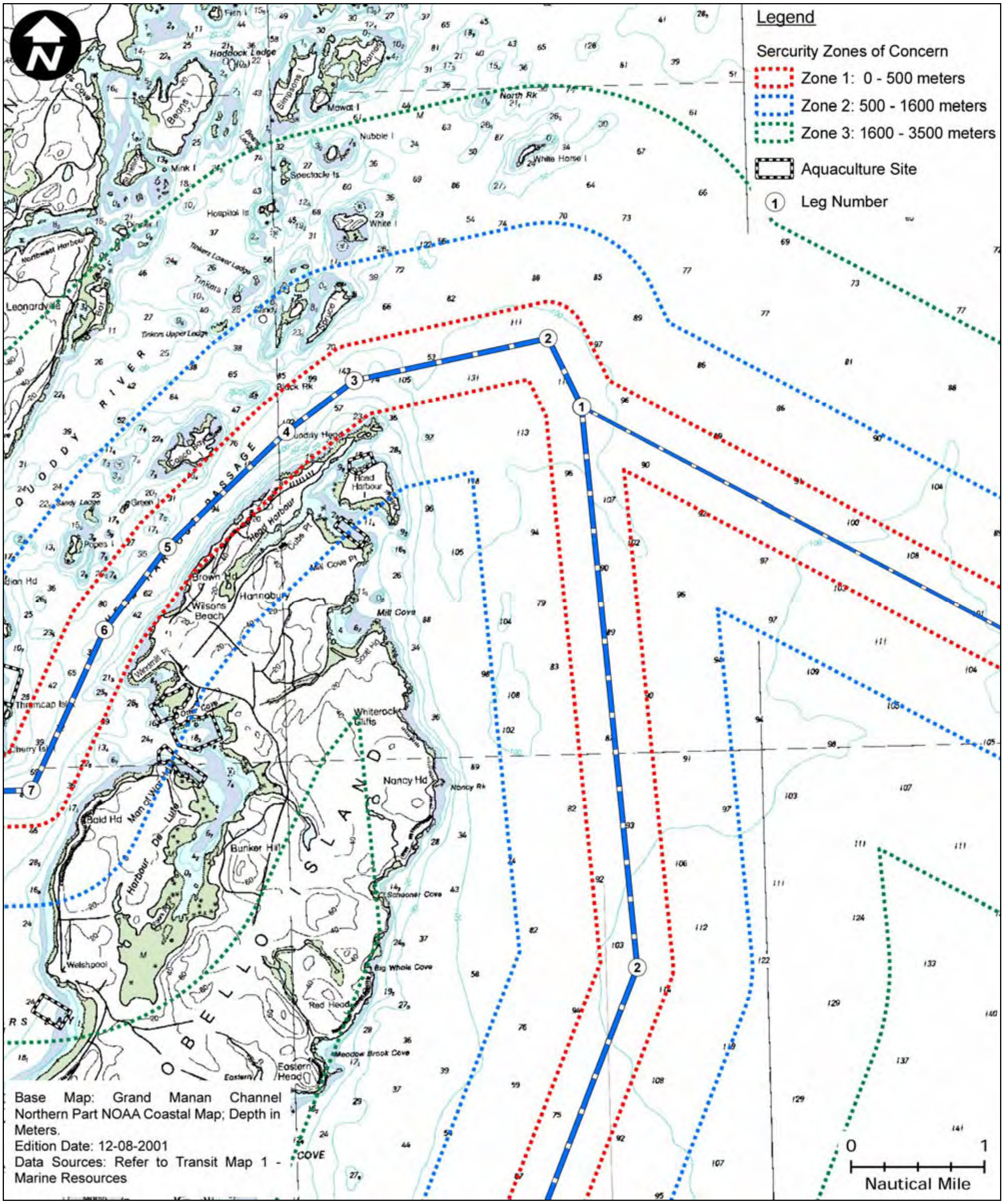
Downeast LNG Project
Waterway for LNG Marine Traffic – Marine Resources: Sheet 2 of 3



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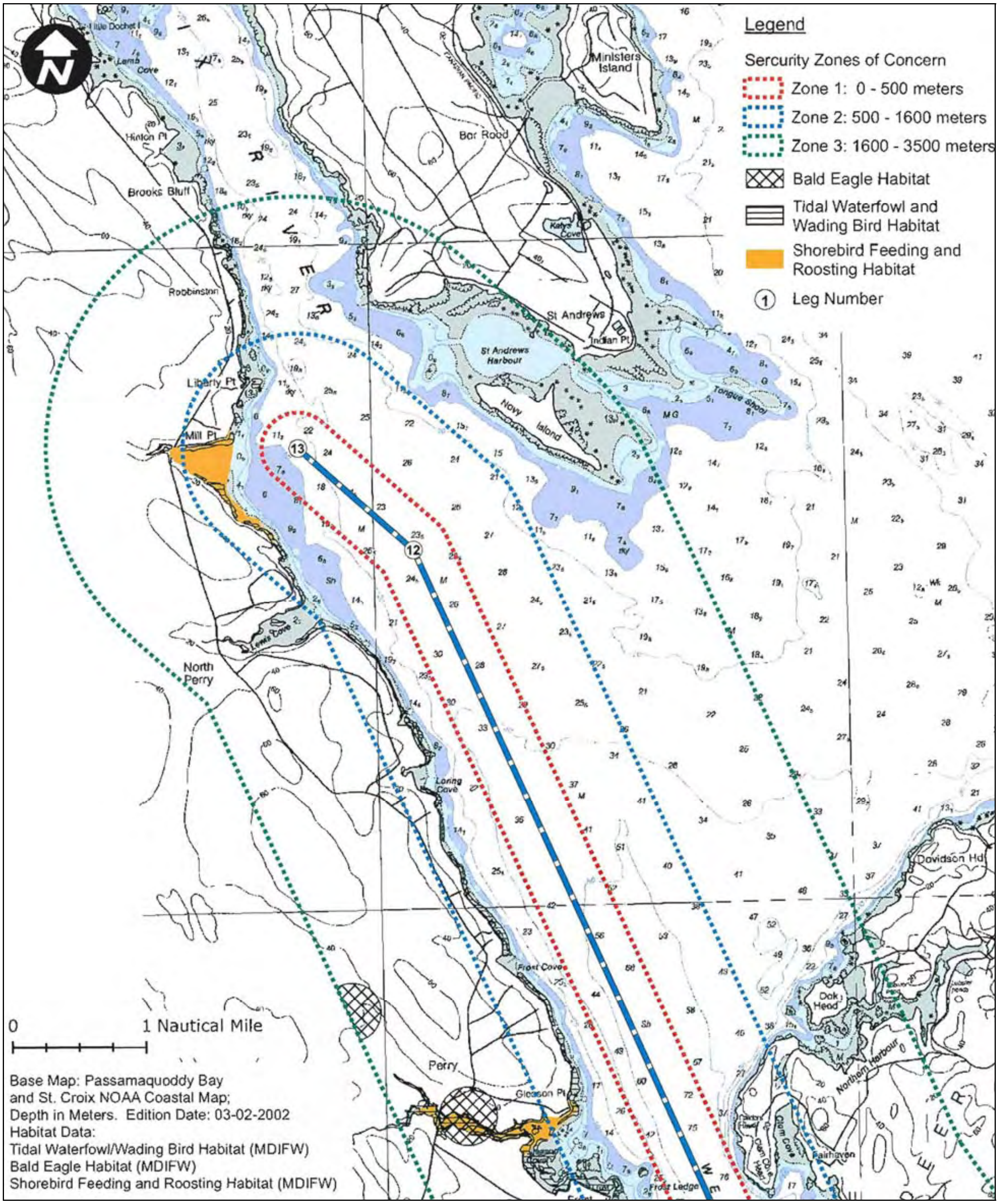

Figure F-14
Downeast LNG Project
Waterway for LNG Marine Traffic – Wildlife Habitat: Sheet 1 of 3

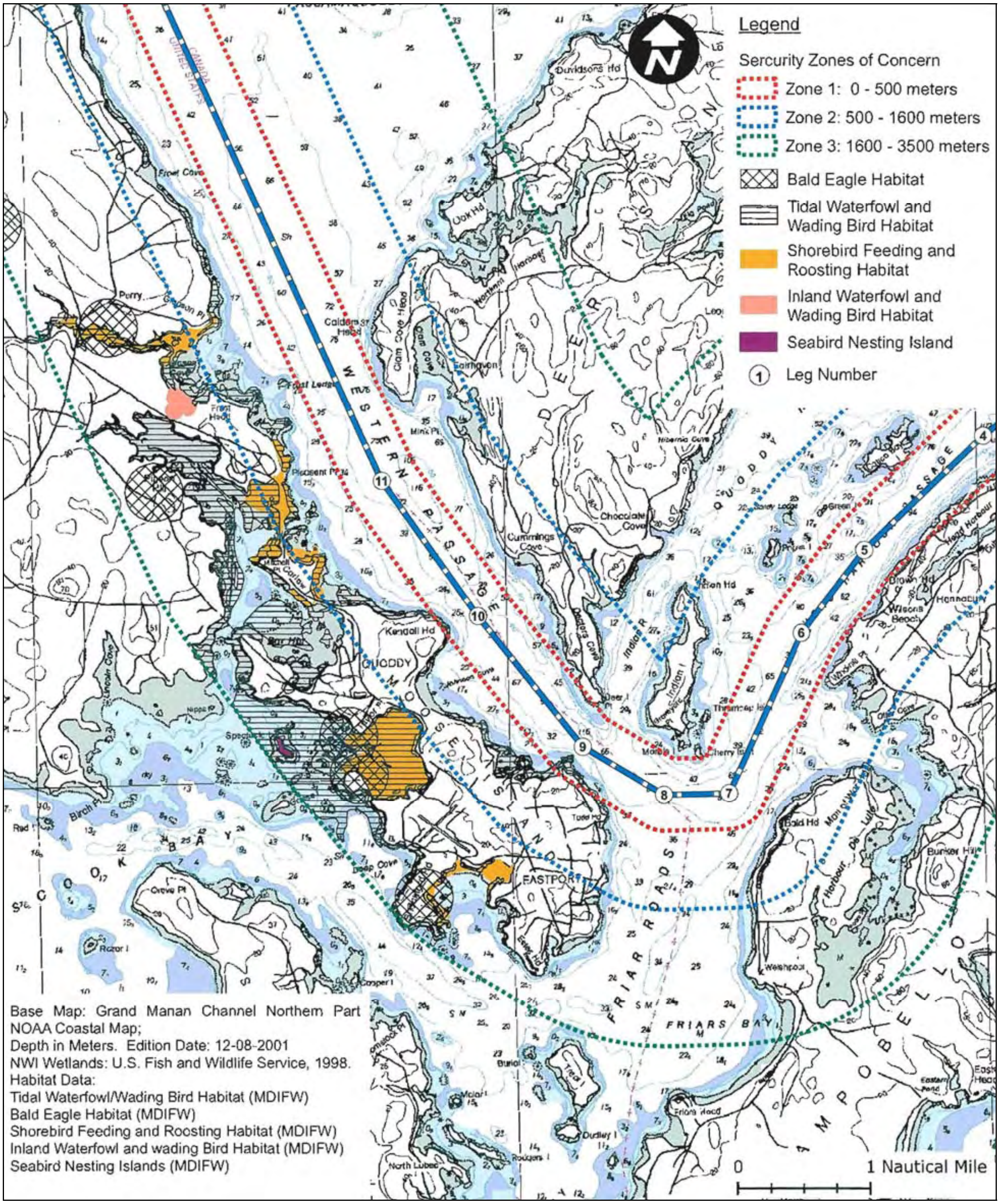

Figure F-15
Downeast LNG Project
Waterway for LNG Marine Traffic – Wildlife Habitat: Sheet 2 of 3

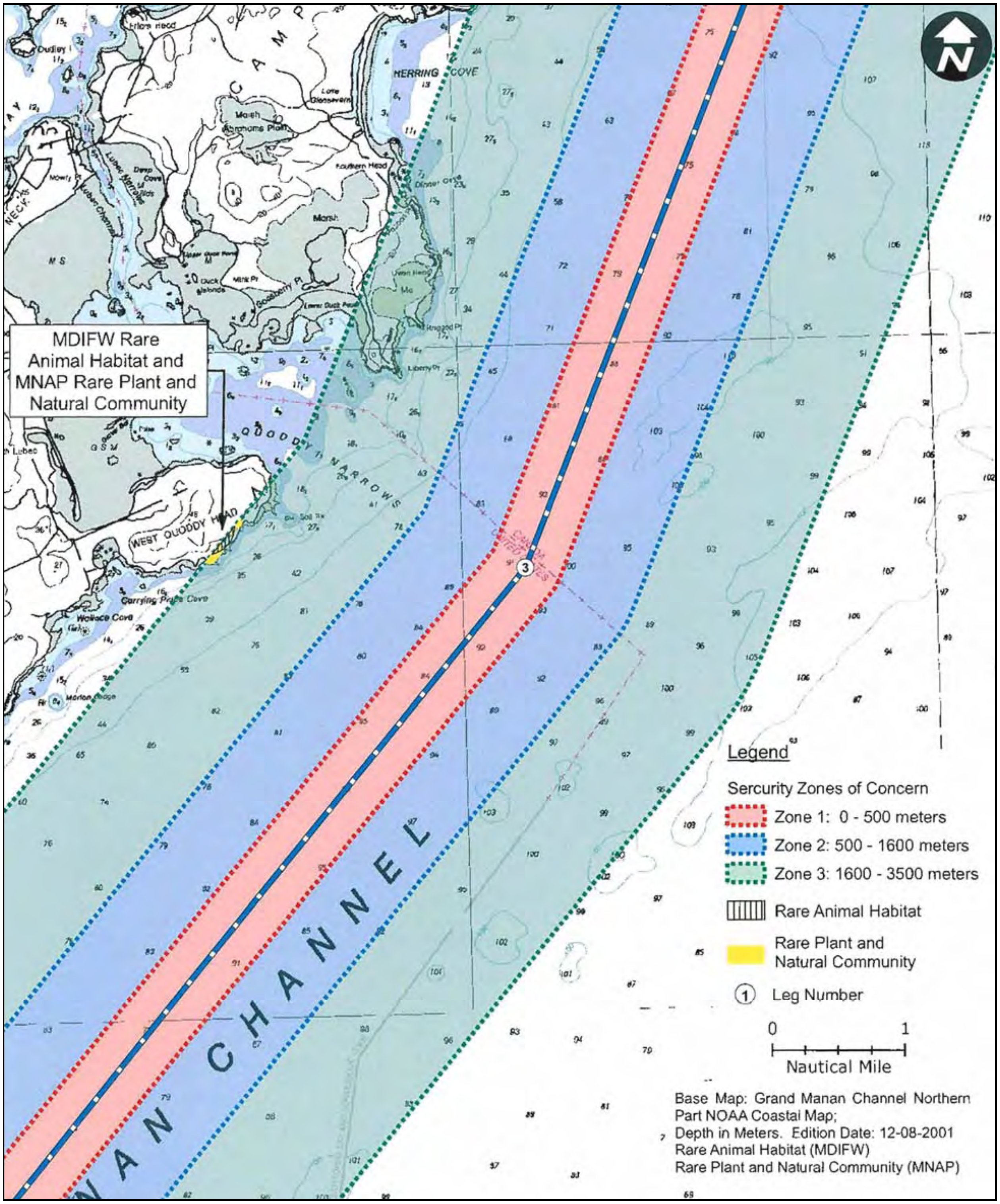

Figure F-16
Downeast LNG Project
Waterway for LNG Marine Traffic – Wildlife Habitat: Sheet 3 of 3

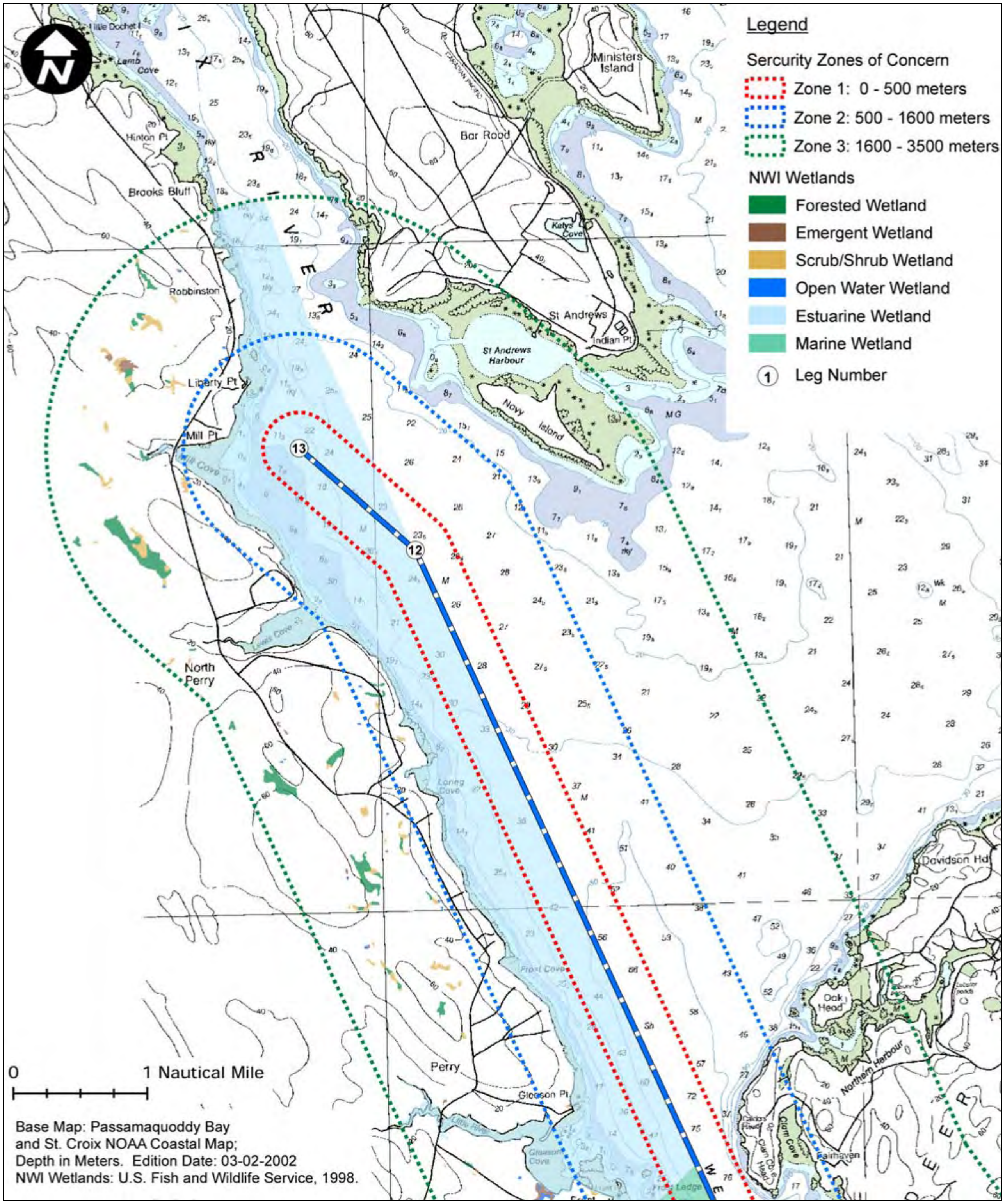

Figure F-17
Downeast LNG Project
Waterway for LNG Marine Traffic – NWI Wetlands: Sheet 1 of 2

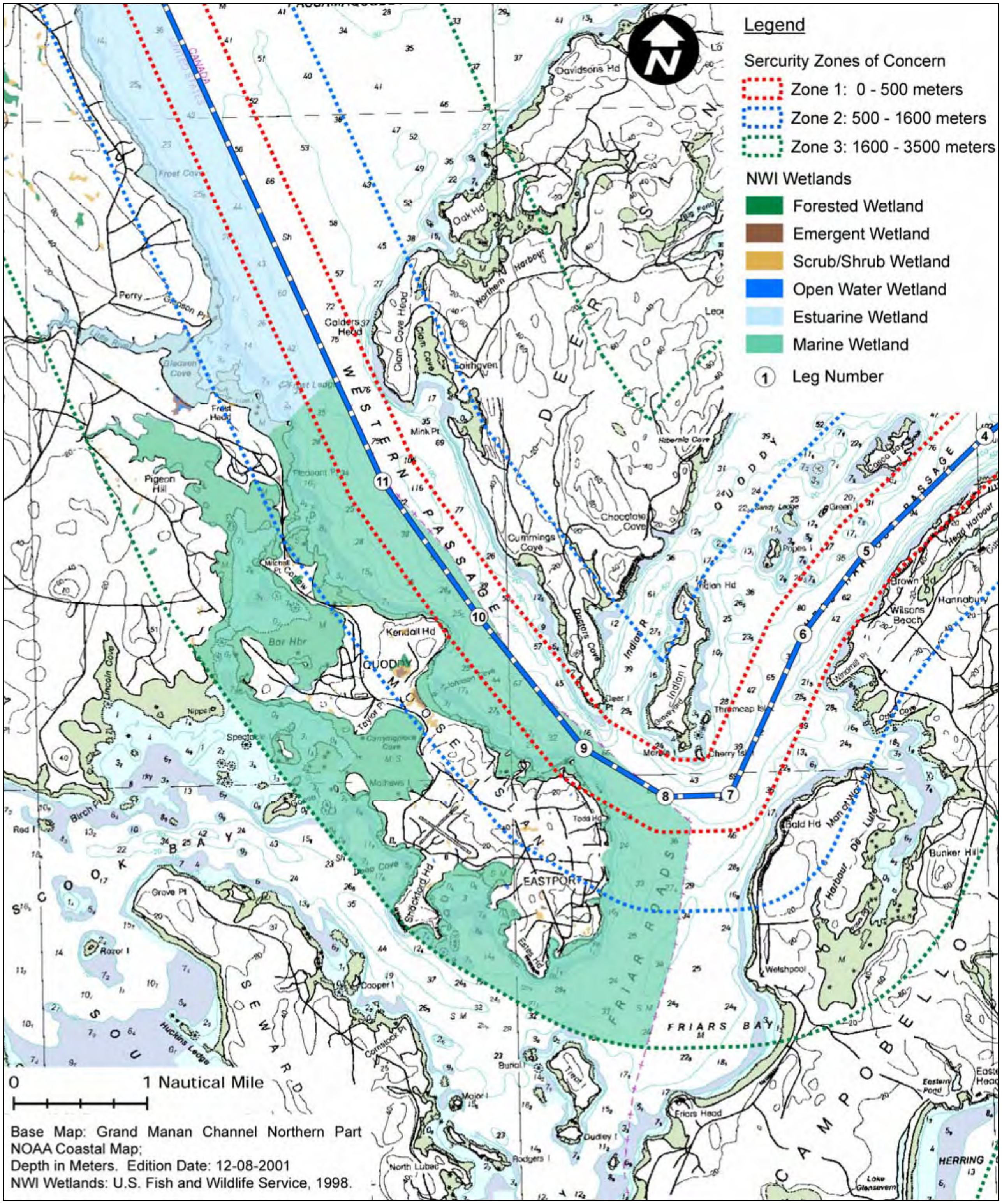

Figure F-18
Downeast LNG Project
Waterway for LNG Marine Traffic – NWI Wetlands: Sheet 2 of 2

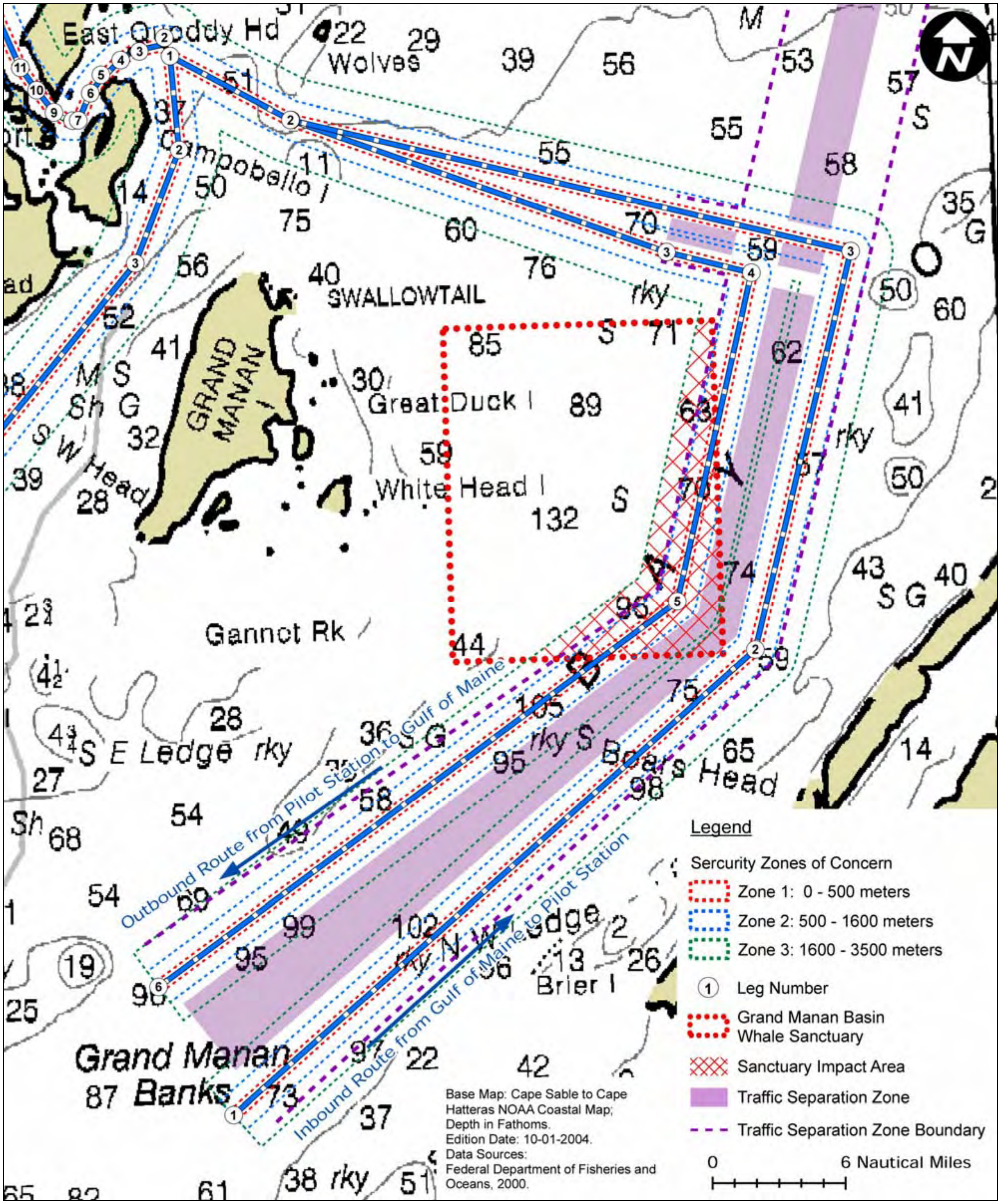

Figure F-19
Downeast LNG Project
Waterway for LNG Marine Traffic – Grand Manan Basin Whale Sanctuary

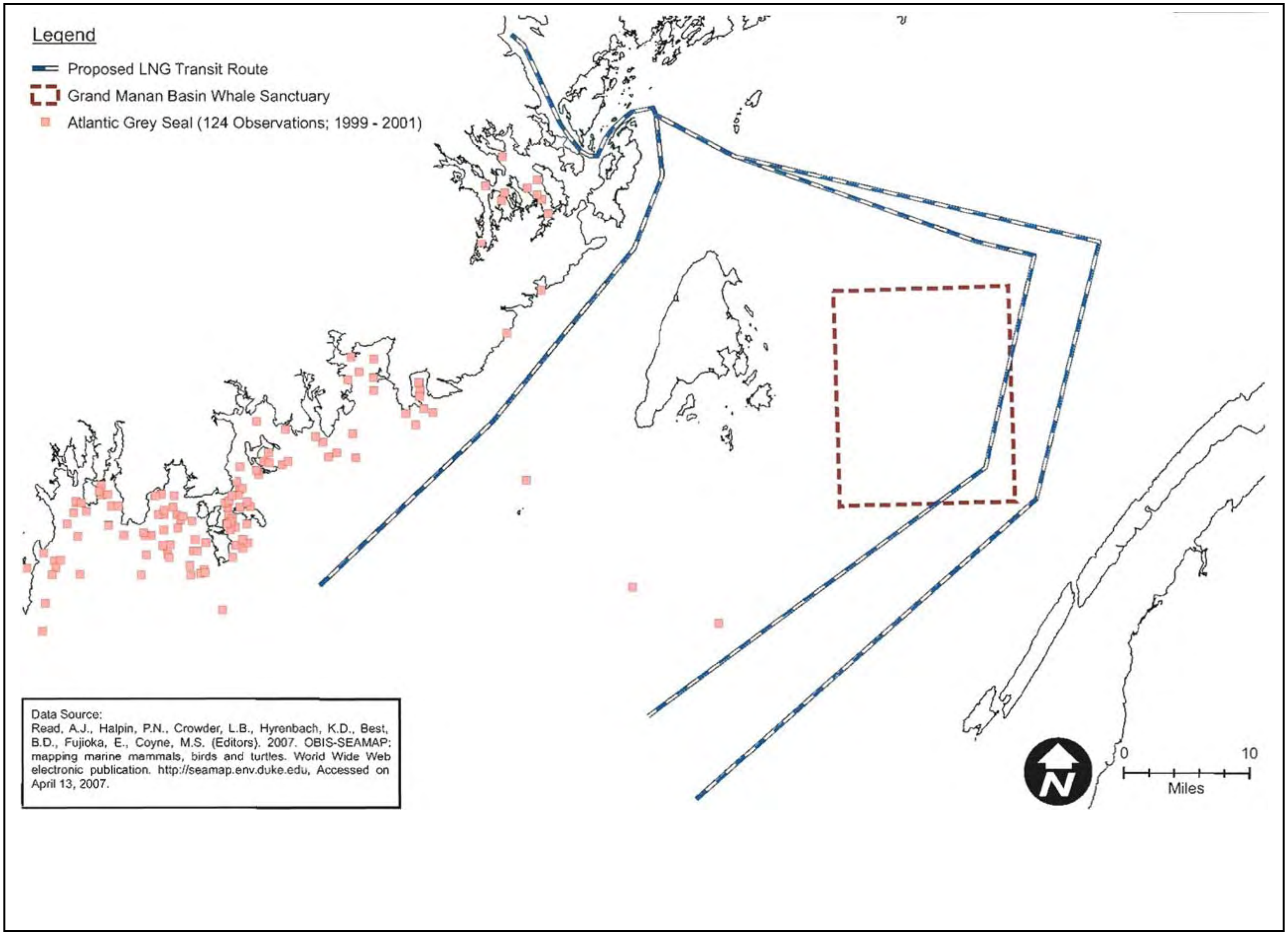

Figure F-20
Downeast LNG Project
Waterway for LNG Marine Traffic – Atlantic Grey Seal Sightings

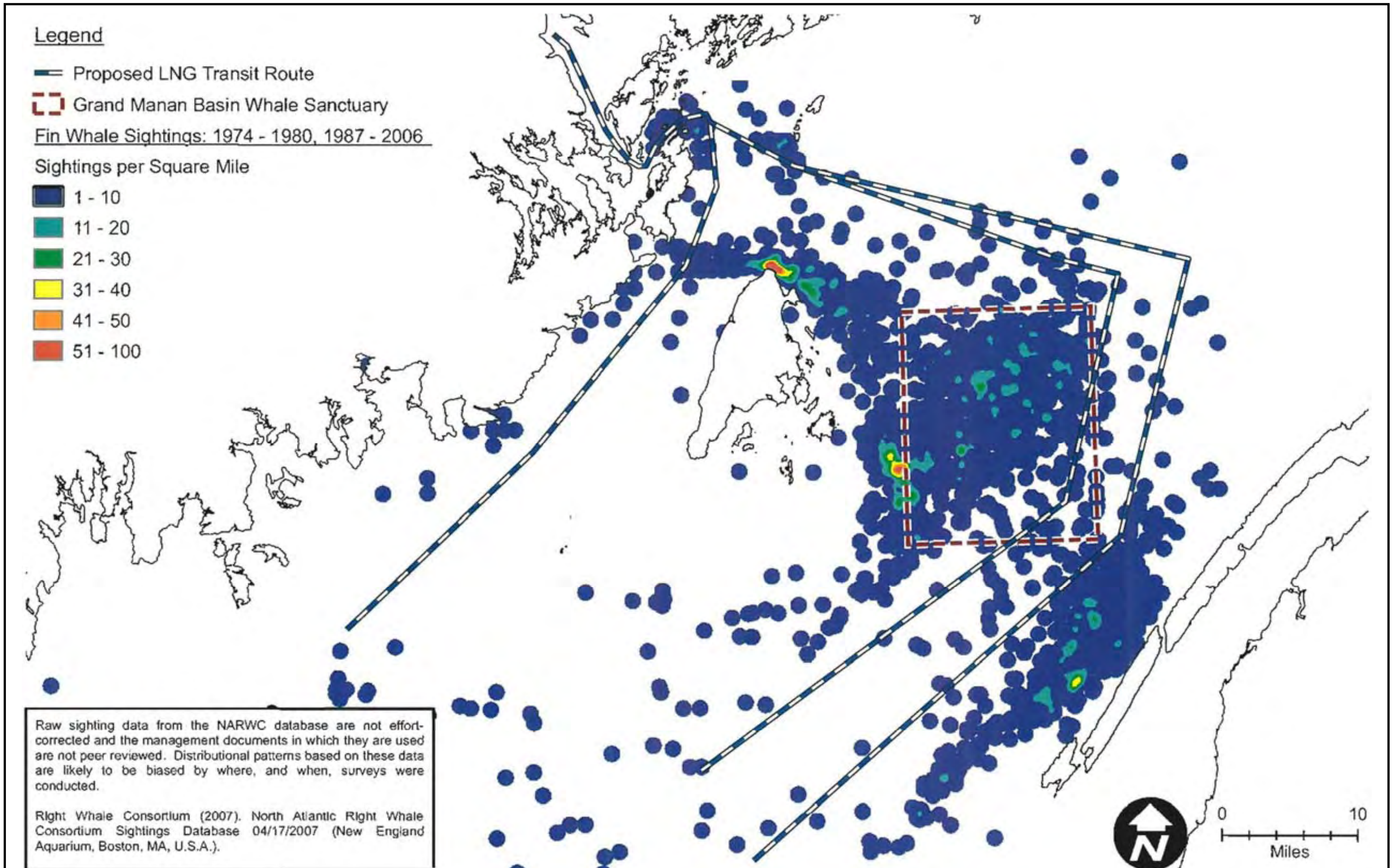

Figure F-21
Downeast LNG Project
Waterway for LNG Marine Traffic – Fin Whale Sightings

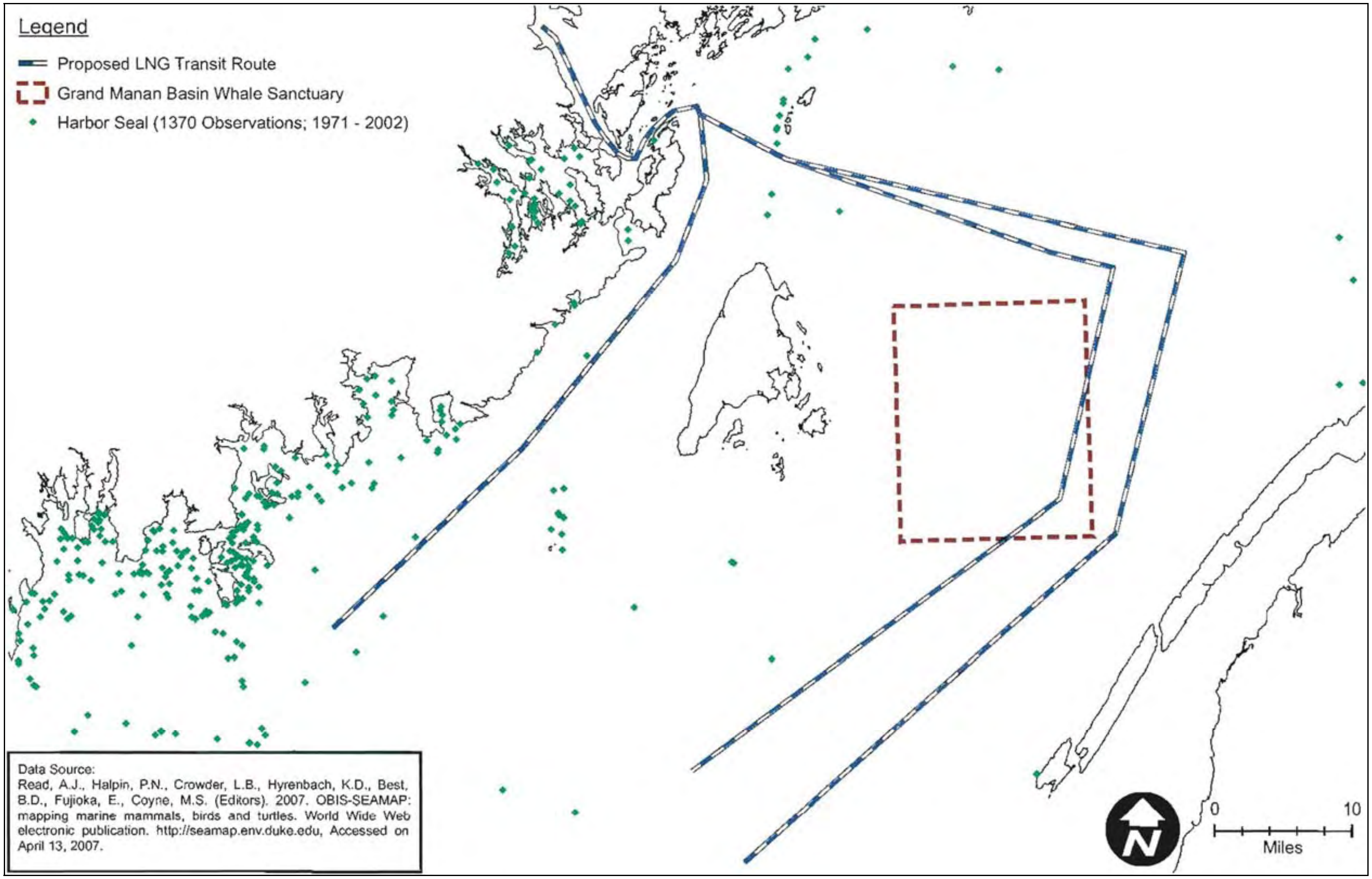

Figure F-22
Downeast LNG Project
Waterway for LNG Marine Traffic – Harbor Seal Sightings

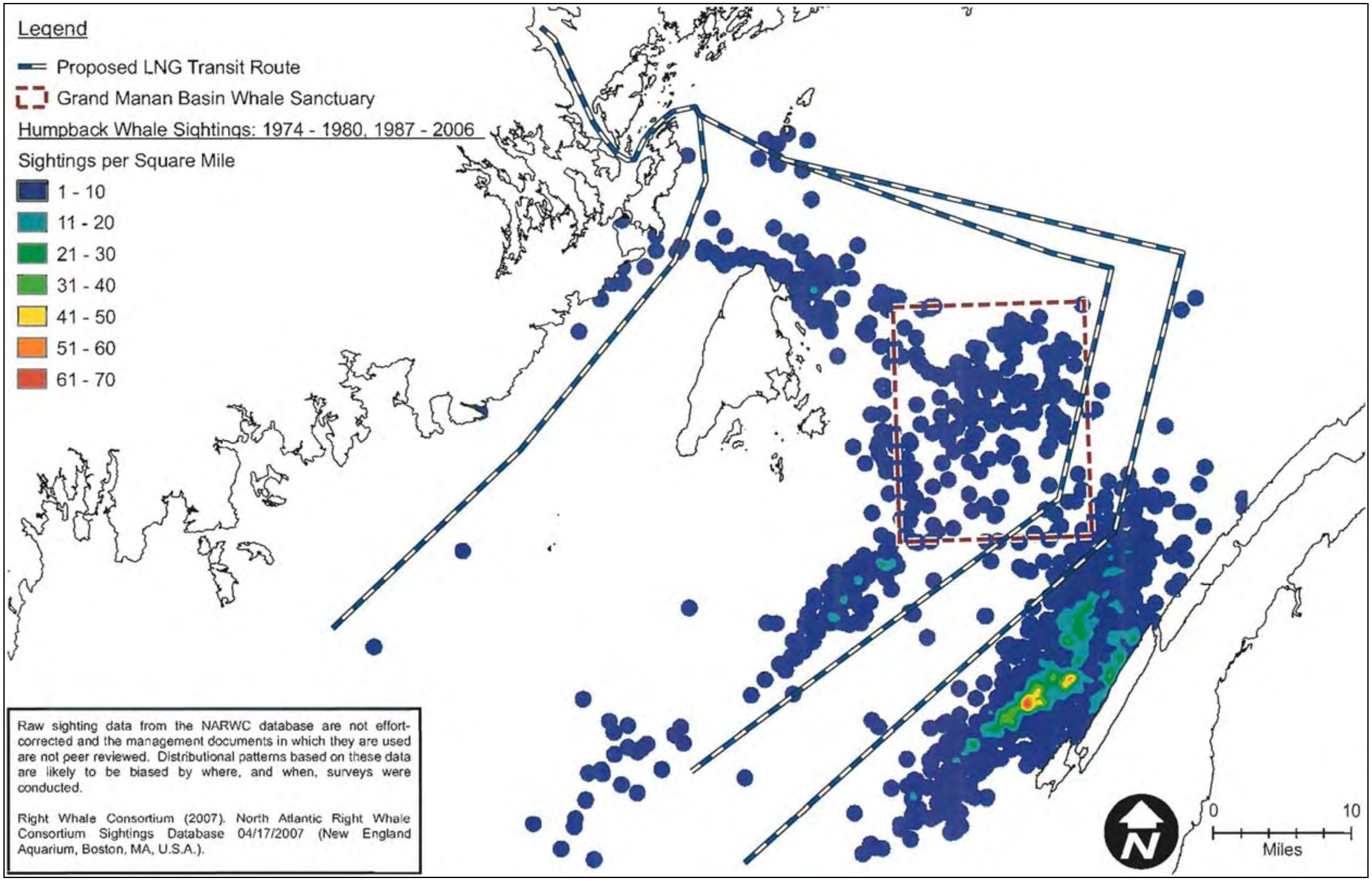

Figure F-23
Downeast LNG Project
Waterway for LNG Marine Traffic – Humpback Whale Sightings

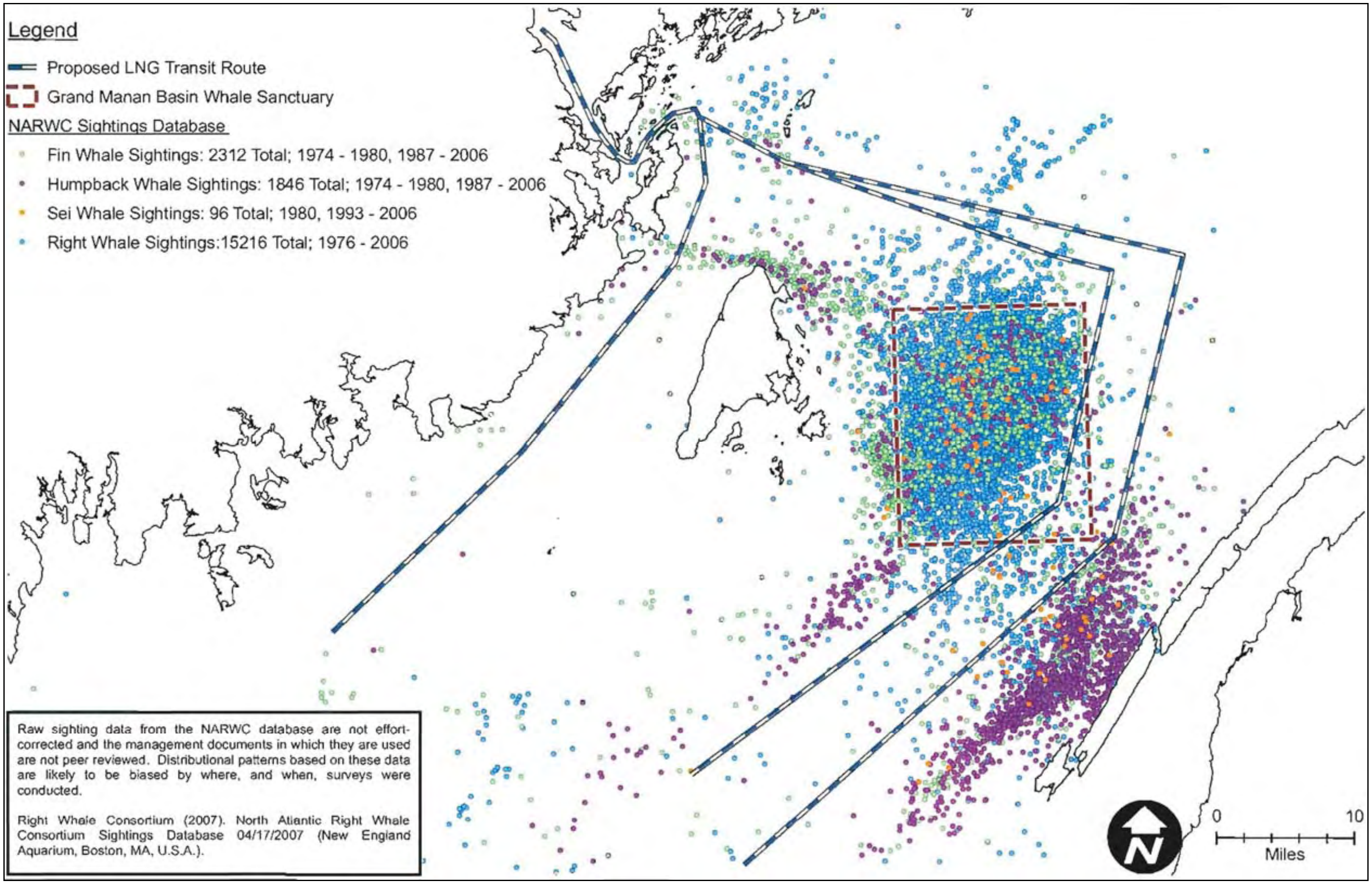

Figure F-24
Downeast LNG Project
Waterway for LNG Marine Traffic – NARWC Sightings

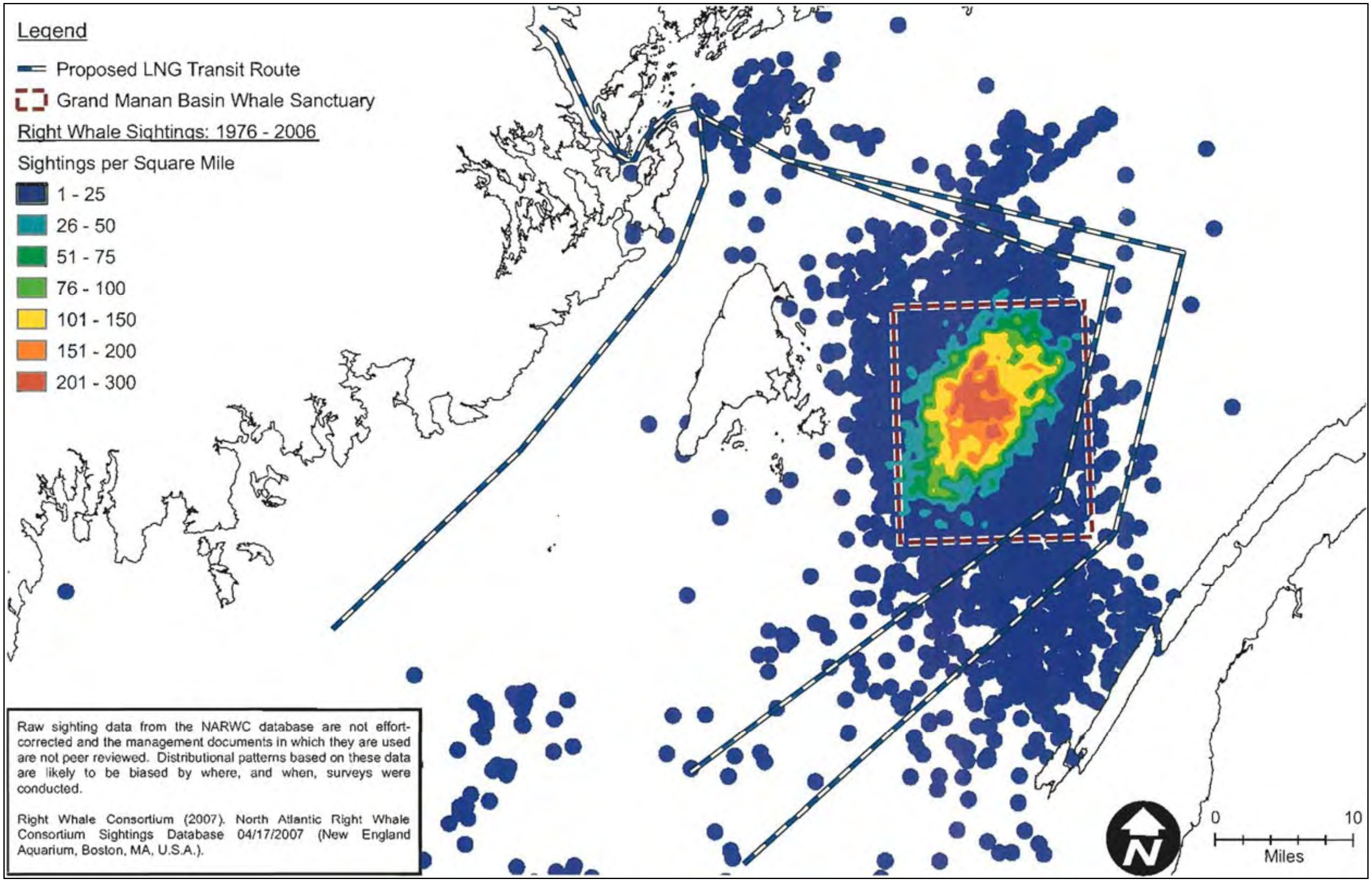

Figure F-25
Downeast LNG Project
Waterway for LNG Marine Traffic – Right Whale Sightings: Sheet 1 of 5

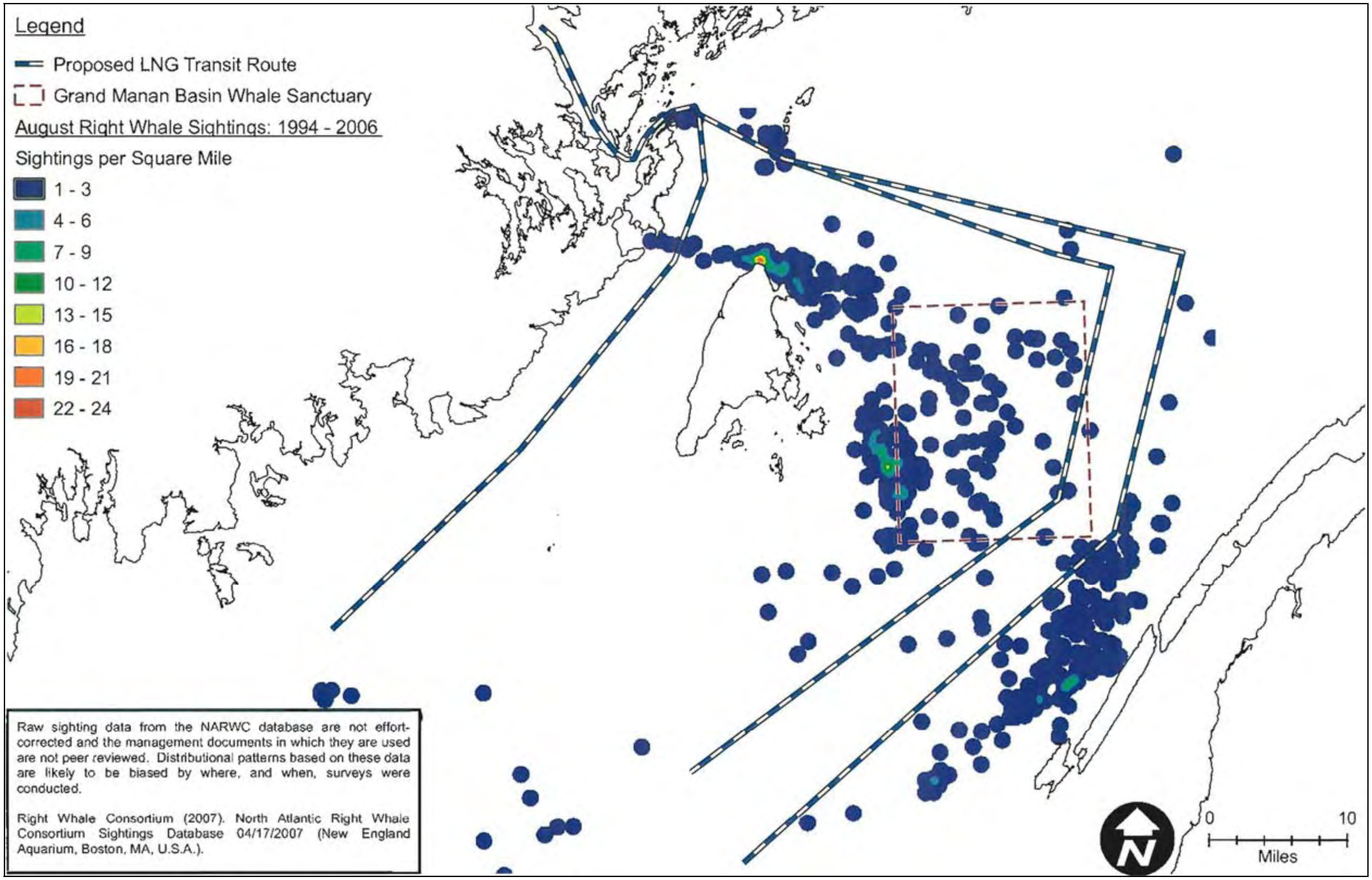

Figure F-26
Downeast LNG Project
Waterway for LNG Marine Traffic – Right Whale Sightings: Sheet 2 of 5

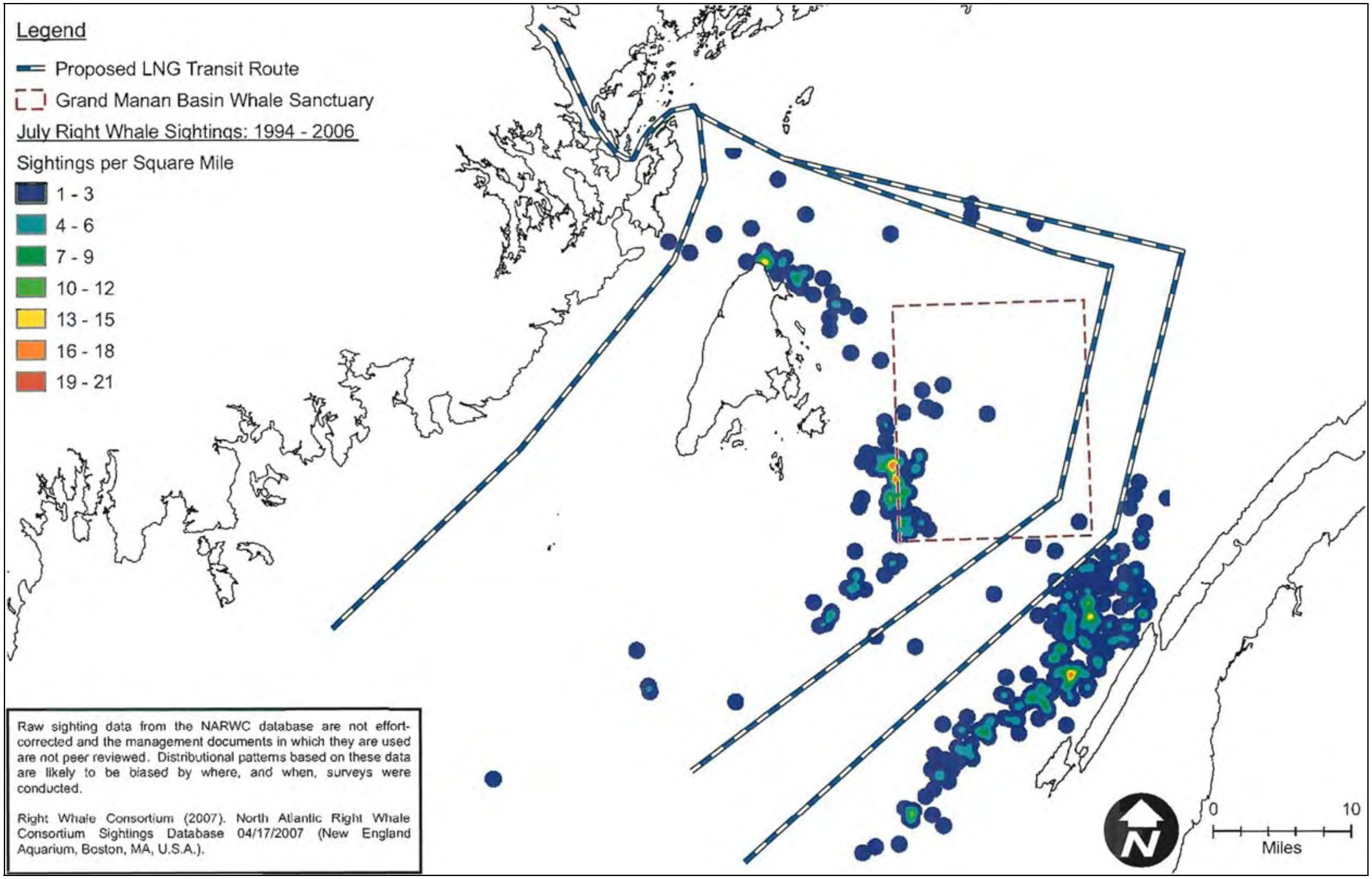

Figure F-27
Downeast LNG Project
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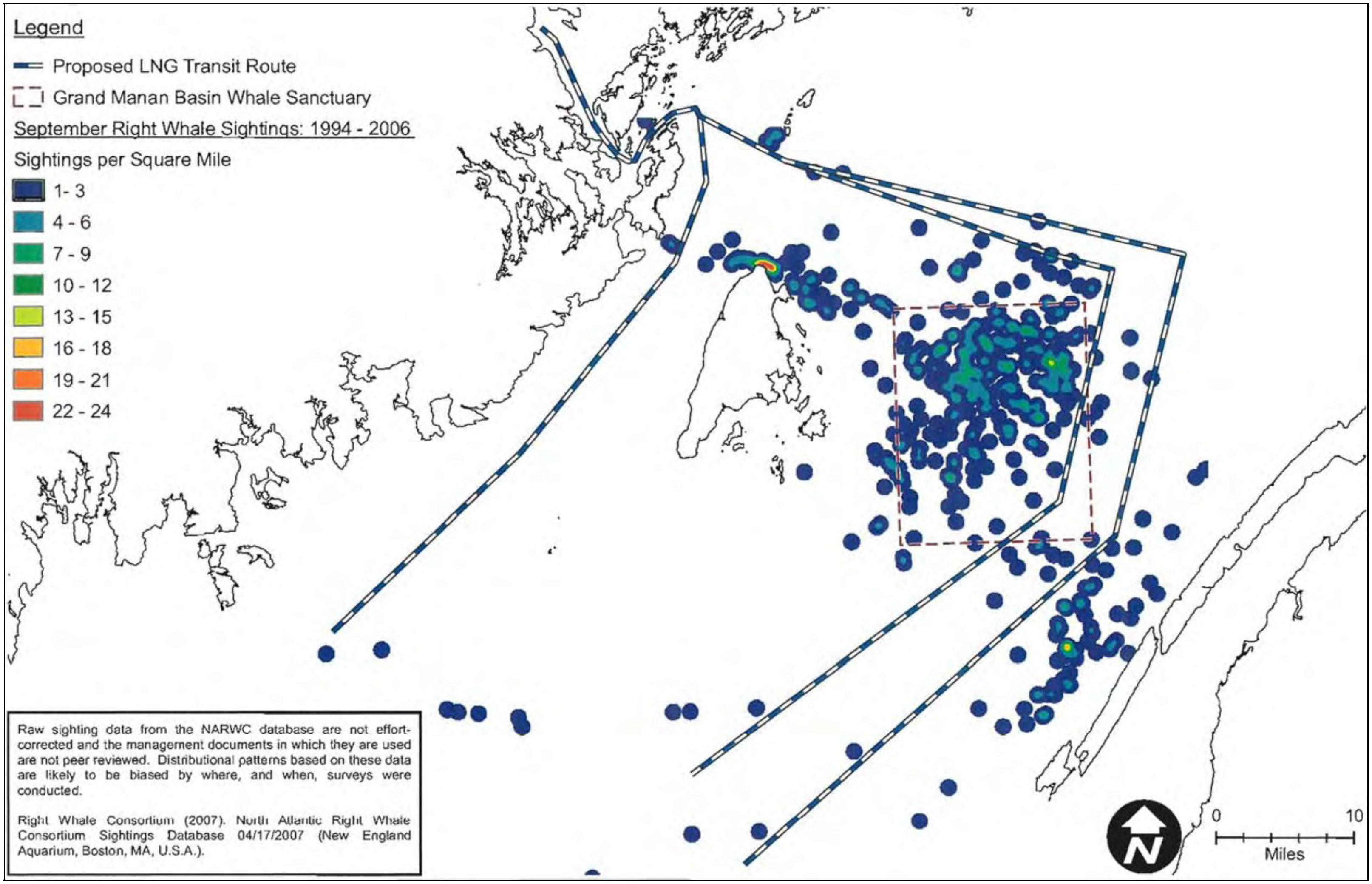

Figure F-28
Downeast LNG Project
Waterway for LNG Marine Traffic – Right Whale Sightings: Sheet 4 of 5

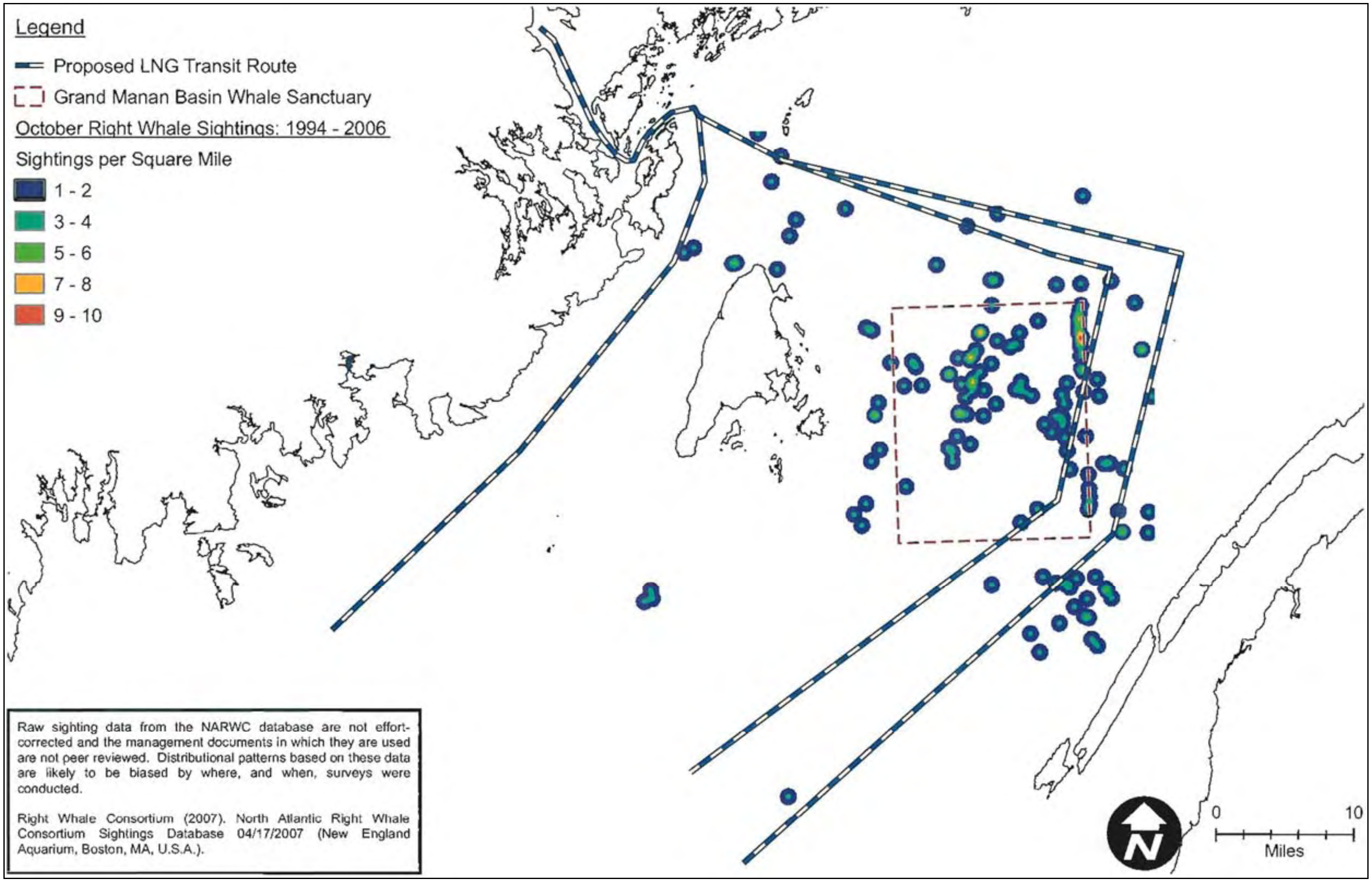

Figure F-29
Downeast LNG Project
Waterway for LNG Marine Traffic – Right Whale Sightings: Sheet 5 of 5

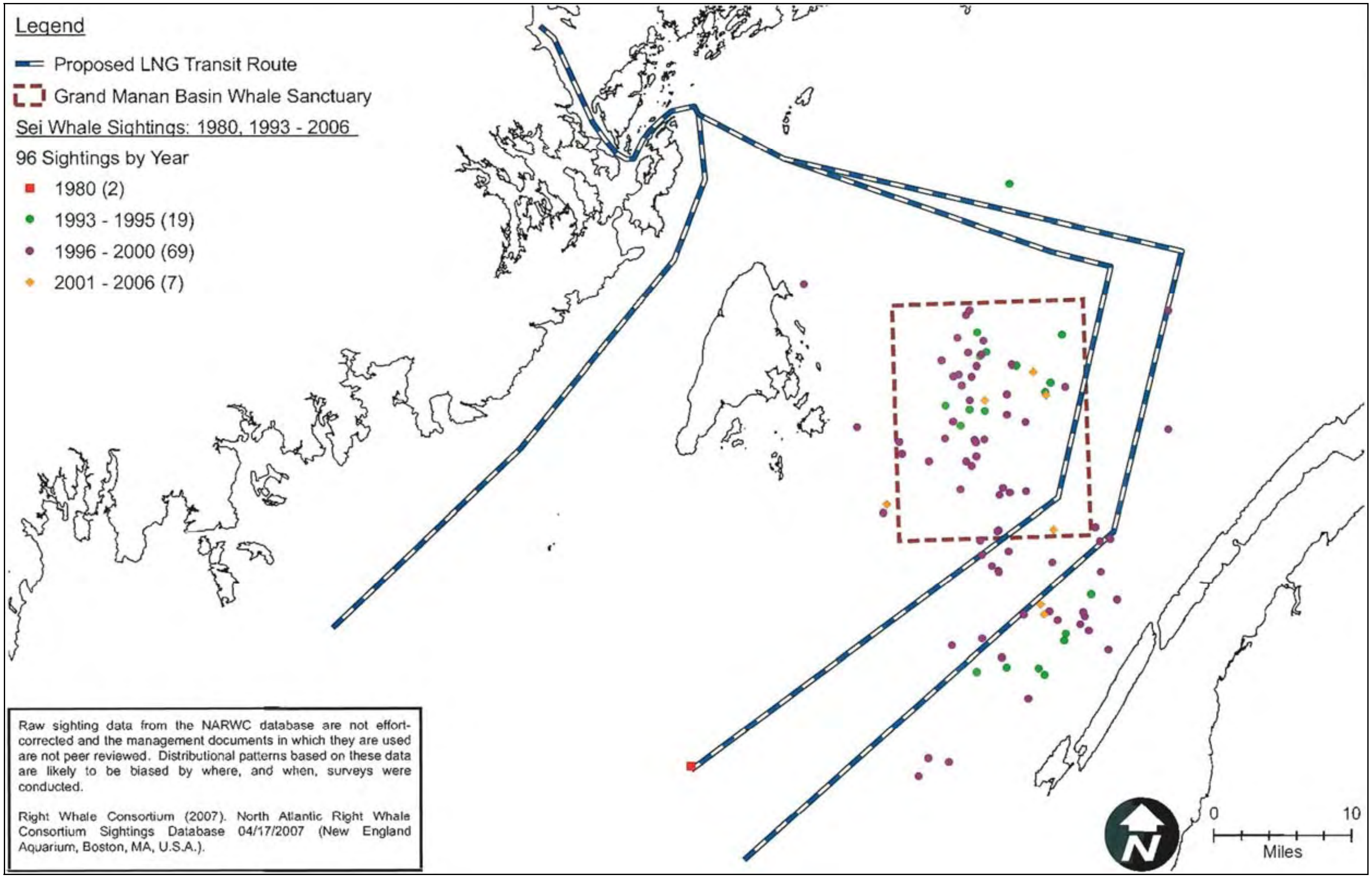

Figure F-30
Downeast LNG Project
Waterway for LNG Marine Traffic – Sei Whale Sightings

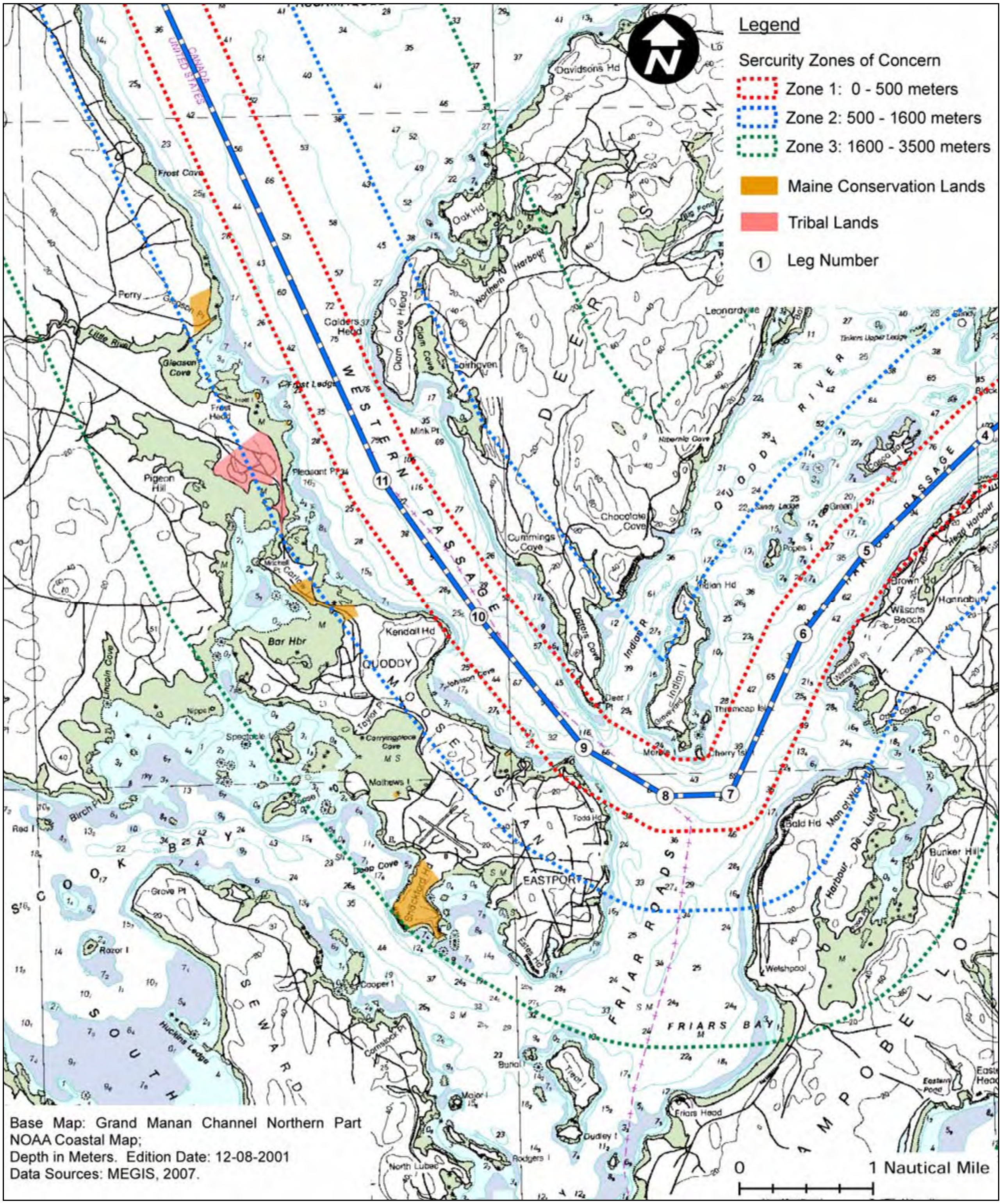

Figure F-31
Downeast LNG Project
Waterway for LNG Marine Traffic – Tribal and Maine Conservation Lands: Sheet 1 of 2

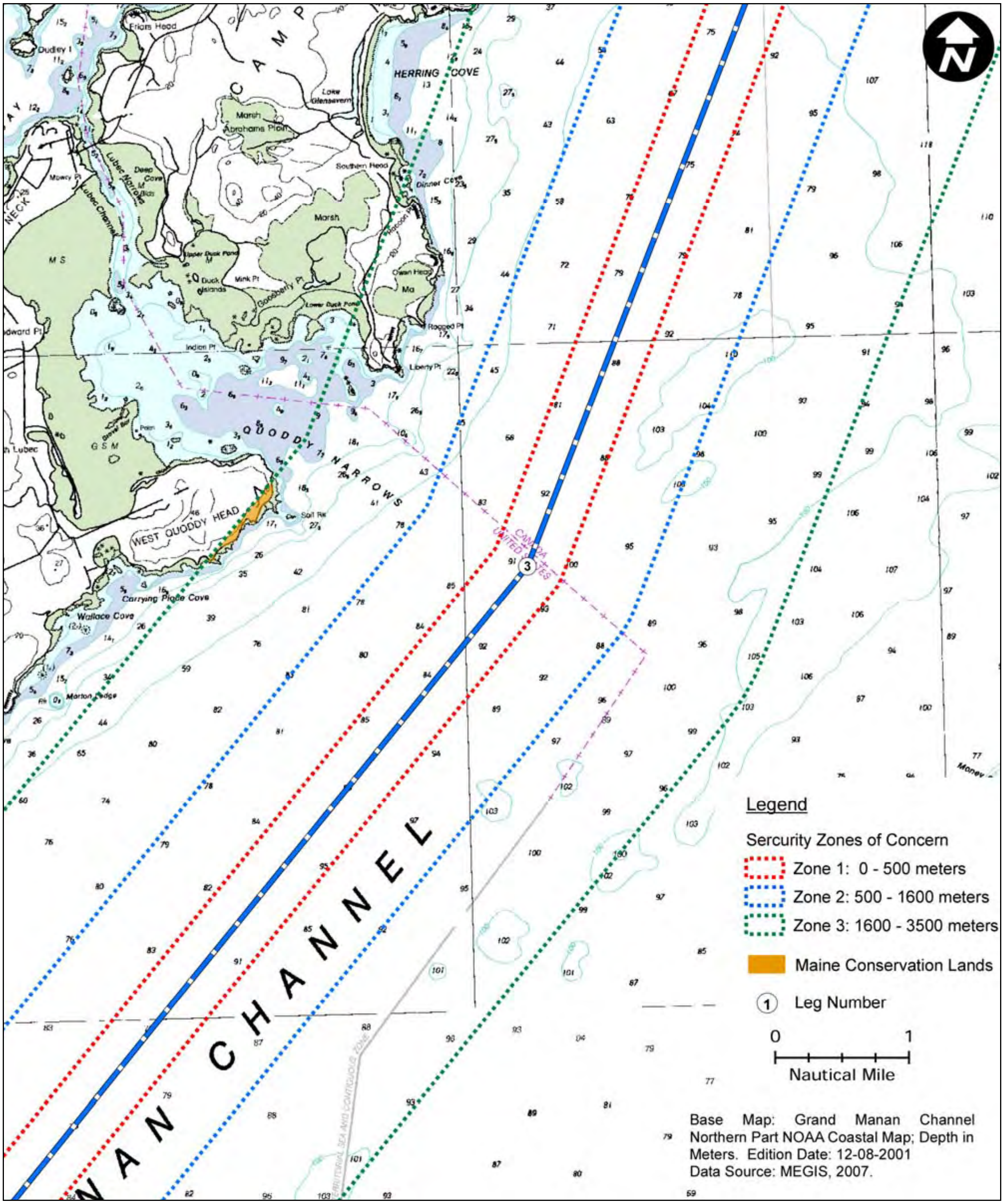

Figure F-32
Downeast LNG Project
Waterway for LNG Marine Traffic – Tribal and Maine Conservation Lands: Sheet 2 of 2

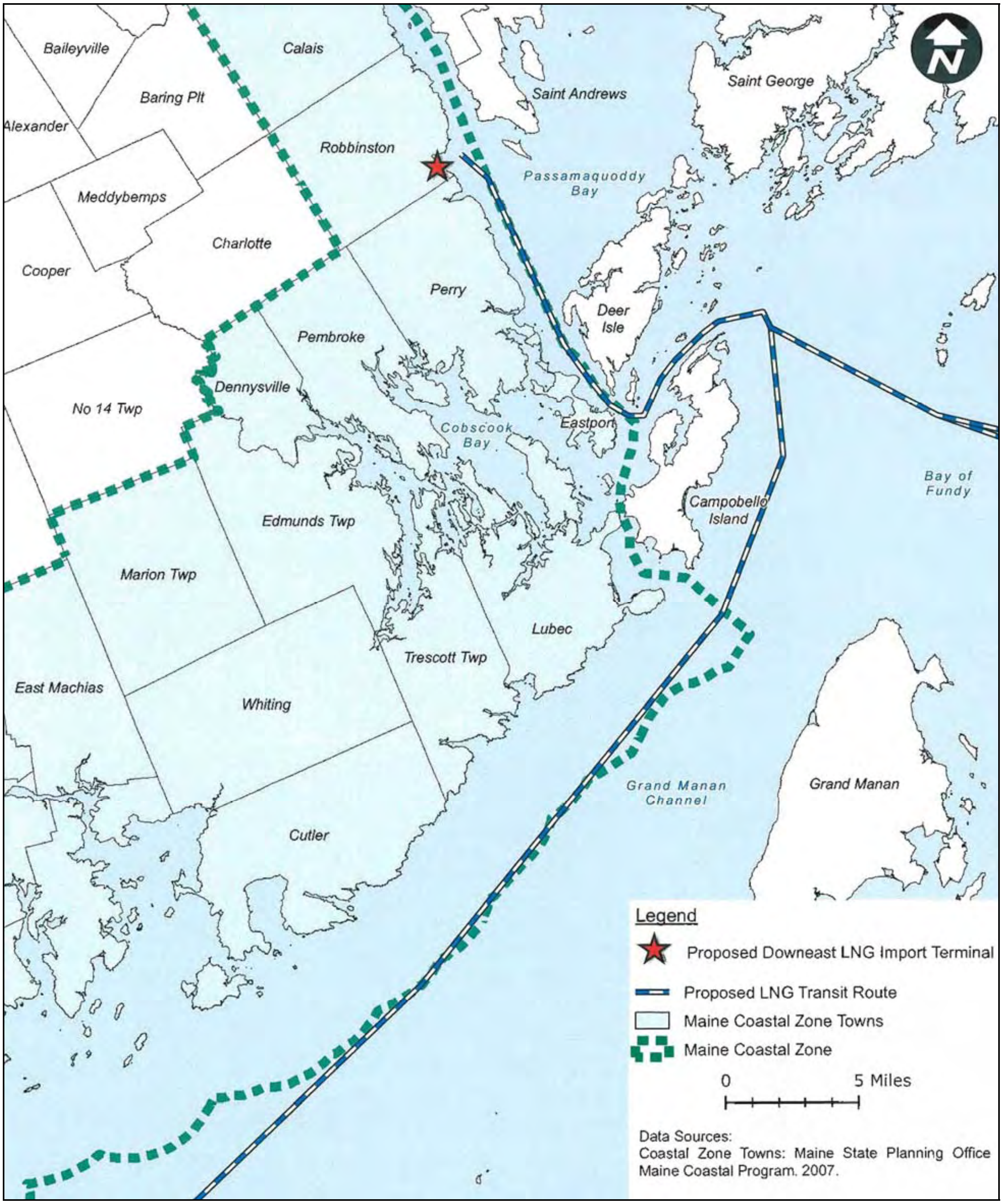

Figure F-33
Downeast LNG Project
Waterway for LNG Marine Traffic – Marine Coastal Zone

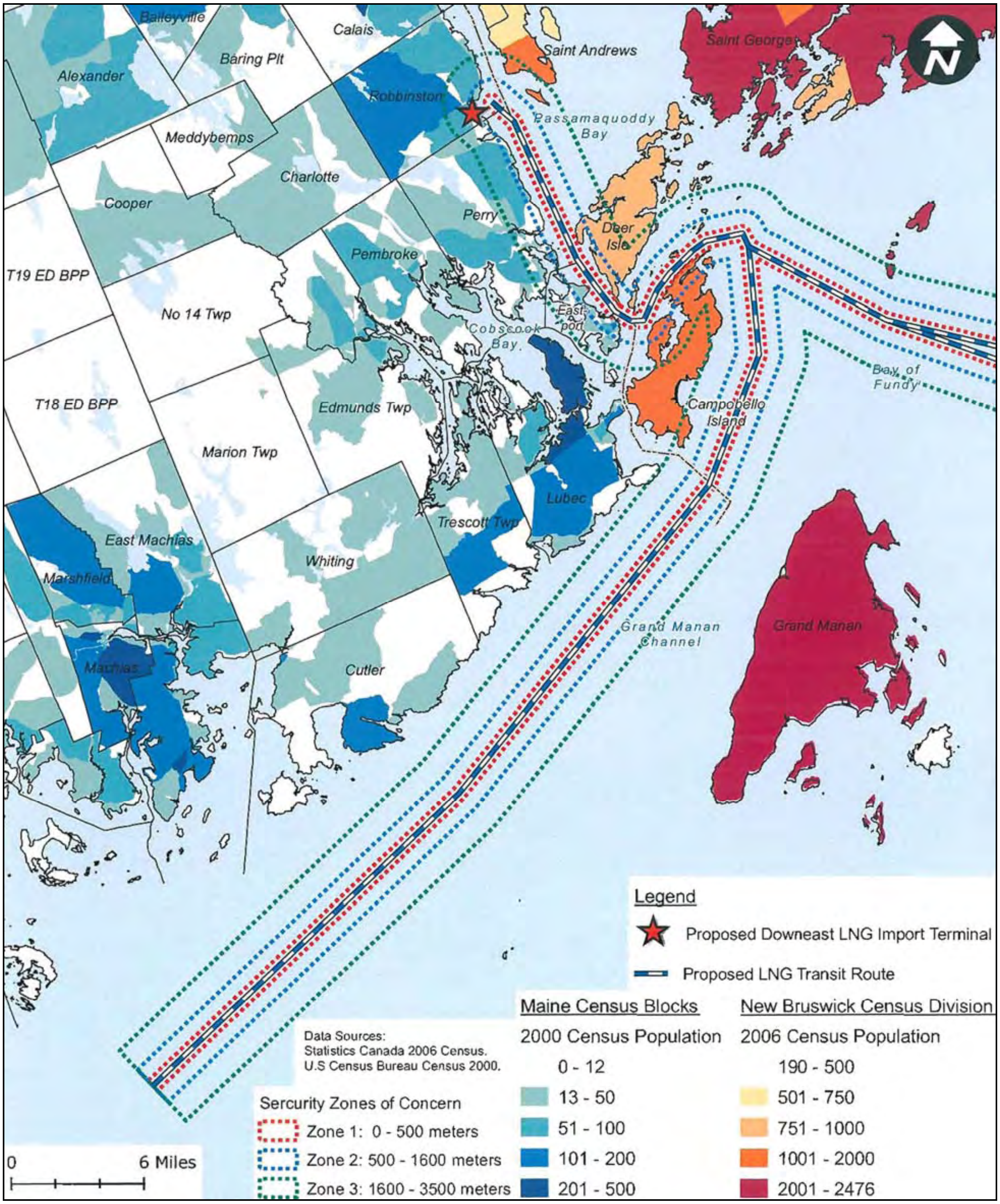

Figure F-34
Downeast LNG Project
Waterway for LNG Marine Traffic – Maine and New Brunswick Population

Figure F-35
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Waterway for LNG Marine Traffic: Atlantic Salmon Habitat in Maine

Appendix G

Essential Fish Habitat Assessment

DOWNEAST LNG PROJECT

Essential Fish Habitat Assessment

April 2014

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ACRONYMS AND ABBREVIATIONS

API	American Petroleum Institute
BMPs	Best Management Practices
BOF TSS	Bay of Fundy Traffic Separation Scheme
BOG	boil-off gas
CFR	Code of the Federal Regulations
COE	U.S. Army Corps of Engineers
Commission or FERC	Federal Energy Regulatory Commission
CORMIX	Cornell Mixing Zone Expert System
DOT	U.S. Department of Transportation
Downeast	Downeast LNG, Inc. and Downeast Pipeline, LLC collectively
DPS	Distinct Population Segment
EFH	essential fish habitat
EI	Environmental Inspector
EIS	Environmental Impact Statement
EMEC	Eastern Maine Electric Cooperative
ESA	Endangered Species Act
FMC	Fisheries Management Council
FMP	fisheries management plans
gpm	gallons per minute
HAPC	Habitat Areas of Particular Concern
HDD	horizontal directional drill
LNG	liquefied natural gas
LOR	Letter of Recommendation
M&NE	Maritimes and Northeast Pipeline L.L.C.
Maine ASC	Maine Atlantic Salmon Commission
Maine DEP	Maine Department of Environmental Protection
Maine DIFW	Maine Department of Inland Fisheries and Wildlife
Maine DMR	Maine Department of Marine Resources
Maine PDES	Maine Pollutant Discharge Elimination System
MLLW	mean lower low water
MLV	mainline valves
MP	milepost
MRSA	Maine Revised Statute Annotated
MSA	Magnuson-Stevens Fishery Management and Conservation Act
MT	Motor Tanker
MTD	Motor Tanker Diesel
MTS	Motor Tanker Steam
NEFMC	New England Fishery Management Council
NEPA	National Environmental Policy Act of 1969
NFPA	National Fire Protection Association
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
Plan	FERC's *Upland Erosion Control, Revegetation and Maintenance Plan*
Procedures	FERC's *Wetland and Waterbody Construction and Mitigation Procedures*
SCV	submerged combustion vaporizer

SPCC Plan	Spill Prevention, Control and Countermeasure Plan
VTS	Vessel Traffic Scheme
WSR	Waterway Suitability Report

1.0 INTRODUCTION

The Magnuson-Stevens Fishery Management and Conservation Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), was established in order to promote conservation of marine fishery resources (shellfish and fish). This included the establishment of eight regional Fisheries Management Councils (FMCs) that develop fisheries management plans (FMPs) to properly manage fishery resources within their jurisdictional waters. The 1986 and 1996 amendments to the MSA, renamed the Sustainable Fisheries Act, recognized that many fisheries are dependent on nearshore and estuarine habitats for at least part of their life cycles and included evaluation of habitat loss and protection of critical habitat. The marine environments important to marine fisheries are referred to as essential fish habitat (EFH) and are defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (NOAA Fisheries 1998). Specifically, w*aters* include aquatic areas and their associated physical, chemical, and biological properties; *substrate* includes sediment, hard bottom, and structures underlying the waters; *necessary* means the habitat required to support a sustainable fishery and the managed species contribution to a sustainable ecosystem; and *spawning, breeding, feeding, or growth to maturity* covers all habitat types utilized by a species throughout its life cycle (NOAA Fisheries 1998). The act also mandates National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) to coordinate with other federal agencies (e.g., the Federal Energy Regulatory Commission [FERC], U.S. Army Corps of Engineers [COE], Coast Guard, etc.) to avoid, minimize, or otherwise offset effects on EFH that could result from proposed activities.

To determine EFH, the regional FMCs map coastal littoral and continental shelf waters. Academic and government fisheries experts then review these data and the scientific literature to determine if these areas constitute EFH for federally managed species. Currently, the Northeast and Mid-Atlantic Regions (Maine to Virginia) have designated EFHs for 59 species. The Northeast Region also contains Habitat Areas of Particular Concern (HAPC) for Atlantic salmon and Atlantic Cod.

The objectives of this EFH Assessment are to describe how the federal actions associated with the Downeast LNG Project may affect EFH designated by the NOAA Fisheries and New England Fishery Management Council (NEFMC). The required contents of an EFH Assessment are: a description of the proposed action (see section 2.0); an analysis of the potential adverse effects of that action on EFH and the managed species including those associated with the marine transit route, and the construction and operation of the terminal, pier, and onshore facilities[1] (see sections 3 and 4); the federal action agency's conclusions regarding the effects of the action on EFH (see section 4); and proposed mitigation, if applicable (see section 5).

In 2009, the FERC staff consolidated EFH consultations for the Downeast LNG Project with the interagency coordination procedures required under National Environmental Policy Act of 1969 (NEPA) and the Endangered Species Act (ESA). On May 19 of that year, the FERC contacted

[1] As discussed in the Project Description section, the Project also includes a natural gas pipeline. The only EFH species potentially affected by the proposed Pipeline is the Atlantic salmon (*Salmo salar),* which requires access to freshwater streams with specific physical characteristics for spawning and early life stages. Downeast LNG conducted detailed stream evaluations during August 2006 based on survey protocols established by the Maine Atlantic Salmon Commission. No potential Atlantic salmon spawning areas were identified during this survey that will be crossed by the Pipeline. Additionally, the stream reaches crossed by the proposed Pipeline corridor were not identified as suitable habitat for Atlantic salmon.

NOAA Fisheries for the purposes of reviewing this project under NEPA. NOAA Fisheries provided recommendations to the FERC on June 25, 2009 regarding mitigation and EFH conservation for the project. NOAA Fisheries indicated that construction and operation of the proposed Downeast LNG Project would result in adverse effects to fishery resources and habitats. NOAA Fisheries recommended that seasonal work restrictions be developed in consultation with federal and state resource agencies, that measures be taken to reduce intake velocity to minimize egg and larval entrainment, and that site-specific HDD plans be developed. In addition, NOAA Fisheries recommend that a biological monitoring plan be presented and that a compensatory mitigation be provided to offset temporary and permanent impacts on fishery resources and habitats. We[2] have responded to each of these conservation recommendations in the sections below.

[2] "We," "us," and "our" refer to the environmental staff of the Office of Energy Projects.

2.0 DESCRIPTION OF THE PROPOSED ACTION

Downeast would construct the LNG terminal in the Town of Robbinston, at the northeastern edge of Washington County, Maine (see figures 2-1 through 2-3). Downeast selected this location after an intensive regional site analysis evaluating 27 potential sites in Maine, Massachusetts, Rhode Island, and Connecticut. The Downeast LNG Project site would be south of the confluence of Passamaquoddy Bay and the St. Croix River between the larger towns of Eastport/Perry and Calais, Maine. The LNG vessels would transit through Head Harbor Passage, Western Passage, and Passamaquoddy Bay to arrive at the proposed terminal (figure 2-4). The LNG terminal would be on the south side of Mill Cove within an approximate 80-acre parcel of private land that Downeast holds an option to purchase. Revaporized LNG would then be transported from the terminal through a single 30-inch-diameter natural gas pipeline which would stretch 29.8 miles to interconnect with the interstate gas pipeline system of Maritimes and Northeast Pipeline L.L.C. (M&NE) near M&NE's Baileyville, Maine compressor station[3] (figure 2-1). A non-jurisdictional electric transmission line and substation also would be constructed in association with the Downeast LNG Project. The following subsections describe the facilities, land requirements, construction, operations, and maintenance of the proposed LNG terminal and sendout pipeline.

2.1 LNG TERMINAL FACILITIES

2.1.1 Proposed LNG Terminal Facilities

The LNG terminal facilities would consist of a vessel unloading facility (one vessel berth and unloading platform), two LNG storage tanks, vaporization and vapor handling system, vent system, hazard detection and response system, hazard control system, metering, and support buildings and piping structures.

A preliminary site configuration and plot plan with trestle layout for LNG vessel offloading is shown in figure 2-3.

The marine terminal for the unloading of LNG vessels consists of the following:

- a 3,862-foot-long, 37-foot-wide pier with a single berth that would accommodate LNG vessels with cargo capacities ranging from 70,000 to 165,000 m^3;
- four manifolded, articulated 16-inch-diameter stainless steel unloading arms, three for LNG delivery and one for vapor return line to the LNG ship; and
- one 36-inch-diameter single walled stainless steel insulated transfer pipeline.

[3] The most recent alignment sheets were filed with the FERC on March 11, 2010 and can be found on eLibrary (http://www.ferc.gov/docs-filing/elibrary.asp) by referencing FERC Docket Nos. CP07-52-000, CP07-53-000, CP07-54-000, and CP07-55-000.

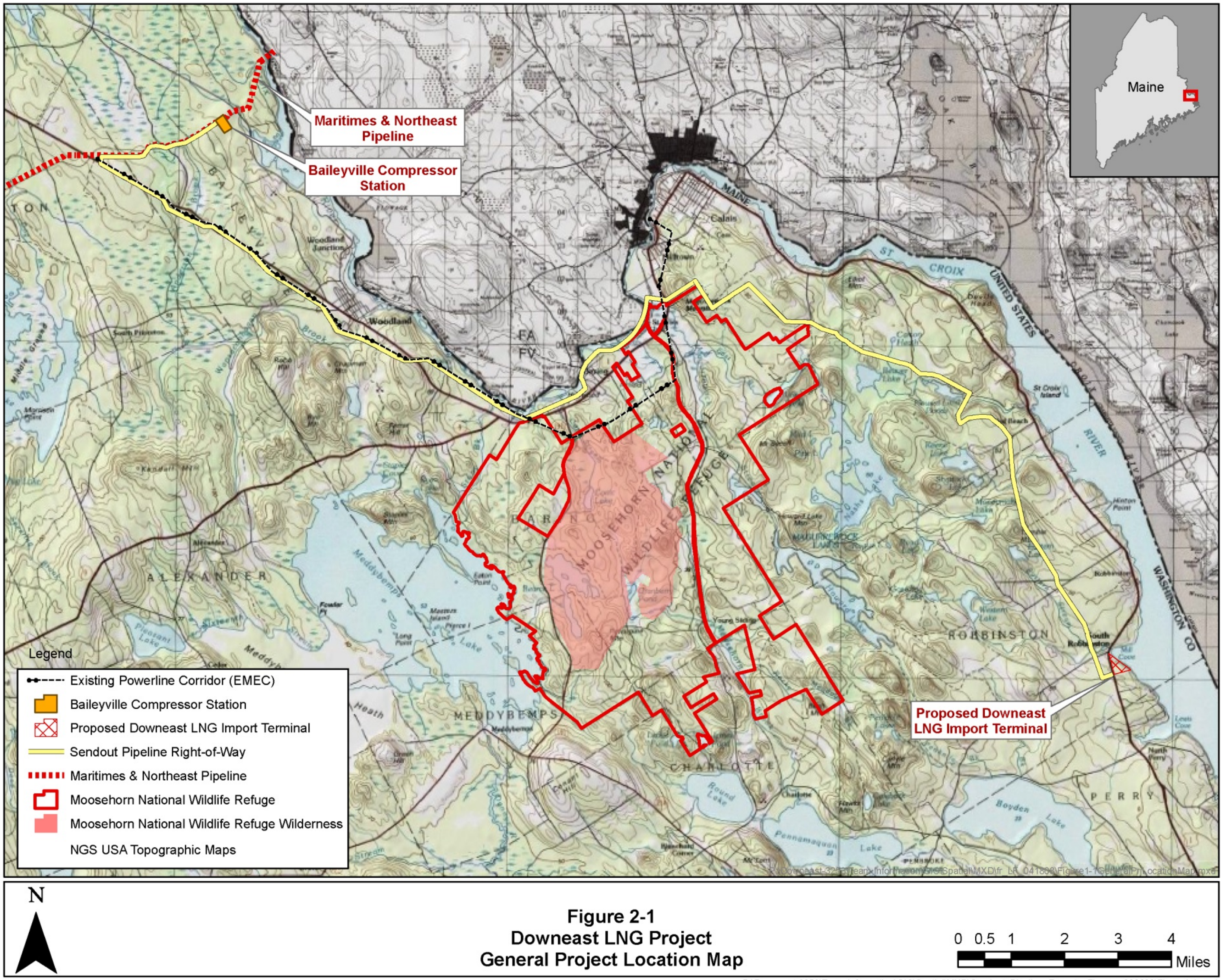

Figure 2-1
Downeast LNG Project
General Project Location Map

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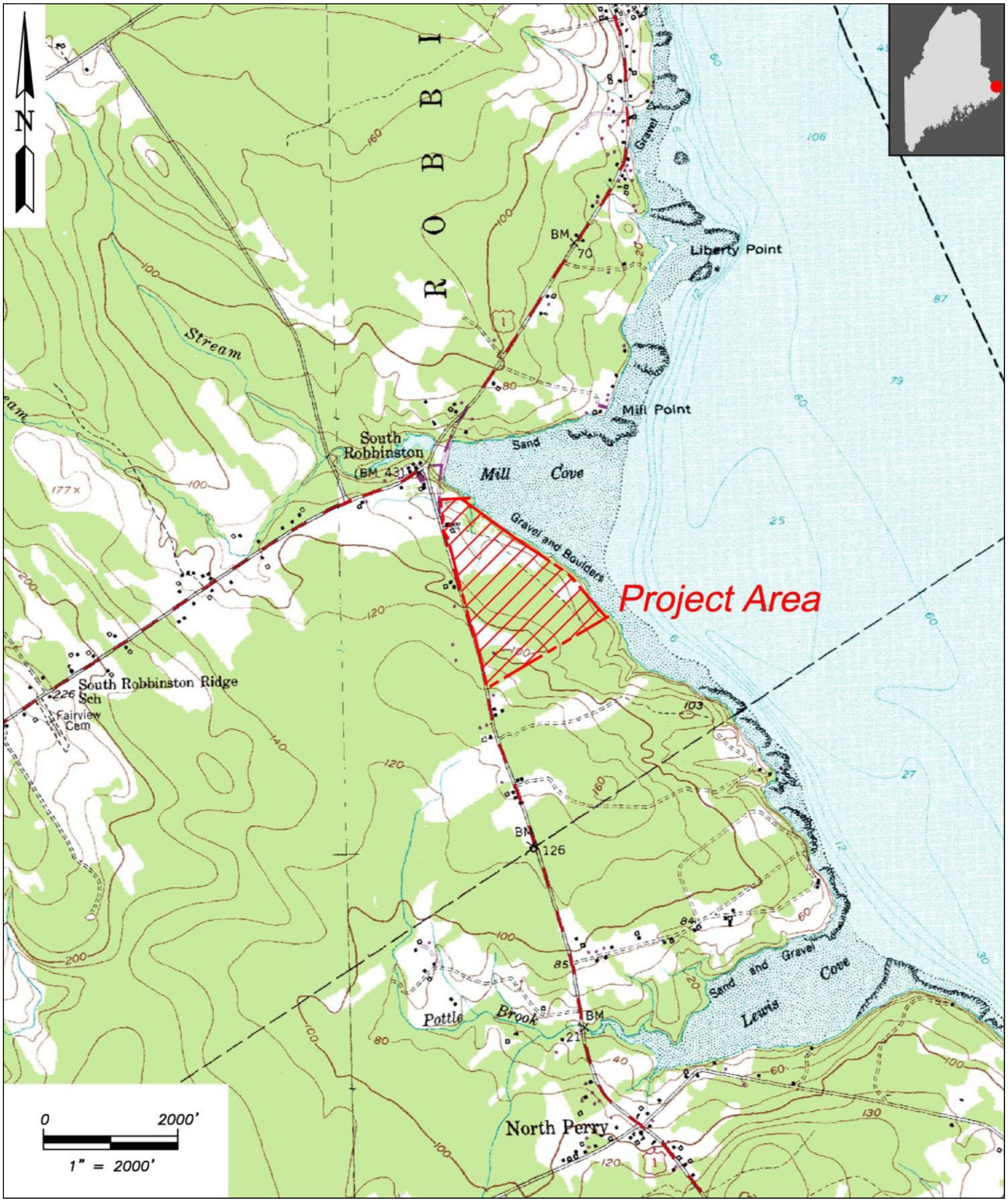

Figure 2-2
Downeast LNG Project
LNG Terminal Location Map

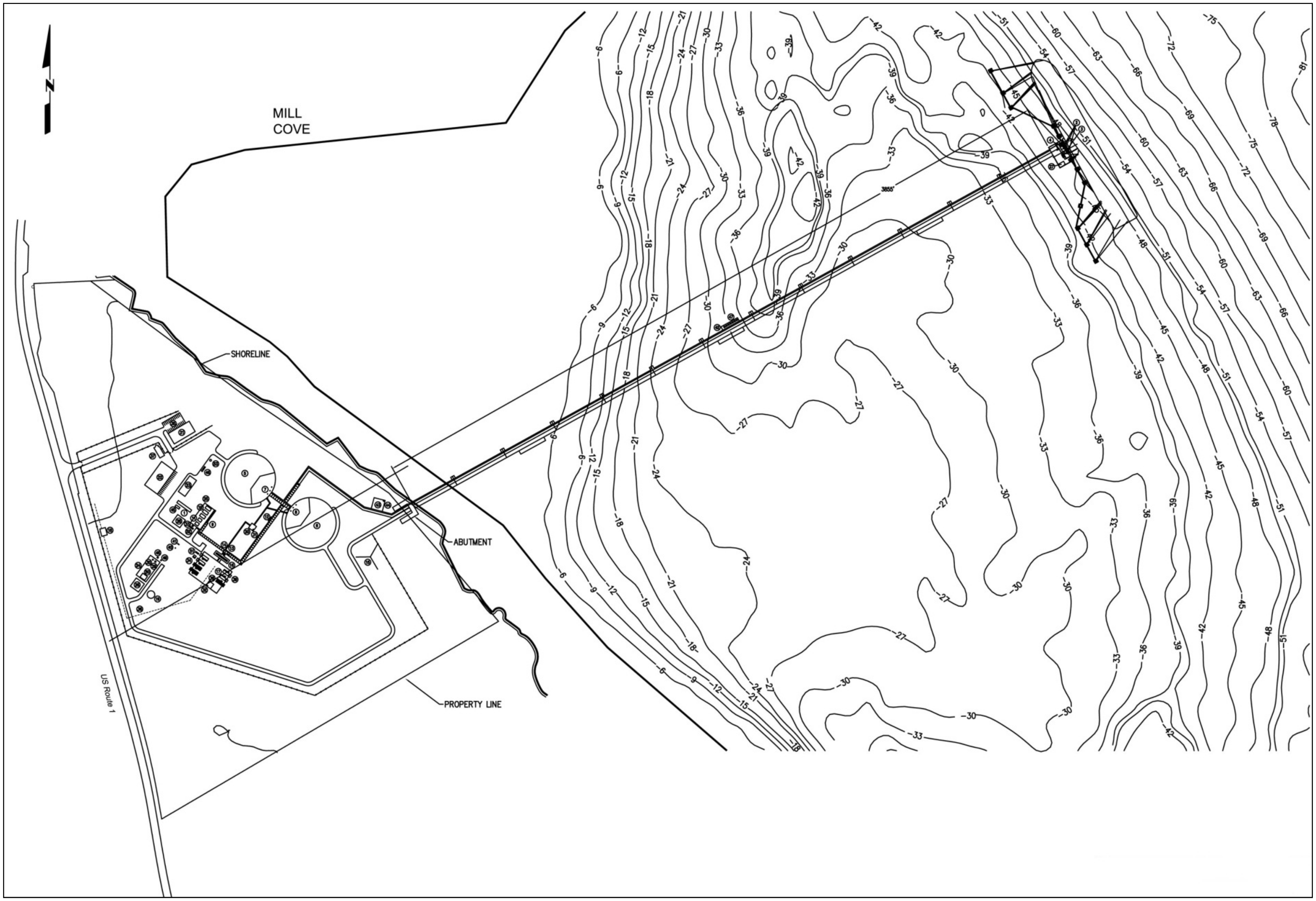

Figure 2-3
Downeast LNG Project
LNG Terminal Plot Plan

Figure 2-4
Downeast LNG Project
Waterway for LNG Marine Traffic

The import terminal site would accommodate the LNG storage facilities, administrative buildings, access roads, and parking areas. The storage terminal consists of the following facilities:

- two insulated LNG storage tanks, each with a nominal usable storage capacity of 160,000 m^3;
- two fully submerged low pressure transfer pumps to transfer the LNG from the storage tanks to the LNG sendout pumps;
- boil-off gas (BOG) recovery system consisting of three BOG compressors, two vapor blowers, and direct contact re-condenser to re-liquefy the BOG;
- four submerged combustion vaporizers (SCV) to re-vaporize LNG to natural gas;
- electrical power distribution, including power substations and transformers;
- ancillary terminal facilities, including control room, maintenance shop, warehouse, office, security, and safety systems;
- measurement controls and natural gas metering facilities; and
- a comprehensive hazard monitoring system incorporating flammable gas detectors, high and low temperature detectors, smoke detectors, and local emergency shutdown controls.

2.1.2 LNG Terminal Facilities Land Requirements

Construction and operation of the proposed LNG terminal would require about 47 acres of the 80-acre parcel. Of the 47 acres required for construction and operation of the LNG terminal, approximately 9 acres of forested and scrub-shrub wetlands would be permanently altered by clearing, grading, and filling. The remaining 33 acres of the terminal site would remain undisturbed to maintain the site's natural vegetation perimeter as well as a setback from the access roads and shoreline. Construction and operation of Downeast's pier trestle and unloading platform would be constructed on 3.6 acres of submerged lands in Passamaquoddy Bay, based on the surface area of the pier, which are owned by the State of Maine. However, only 0.1 acre of submerged land (subtidal and intertidal wetlands) would be directly disturbed by the pilings. Table 2.1.2-1 summarizes the land requirements for the proposed LNG terminal. Access to the LNG terminal would be by way of U.S. Route 1.

Several temporary facilities would also be required to support the construction effort. These include offices, sanitary facilities, warehouses, construction laydown areas, construction utilities, access roads, security infrastructure, and fencing. Off-site staging areas would be used for some fabrication, employee parking, and material/equipment storage.

The primary laydown area would be within the disturbed area for the LNG terminal. As the construction progresses on the site, open areas available for construction laydown may become more limited and off-site areas would be used for the overflow if needed. The three off-site areas that would be used as overflow sites are previously disturbed by logging, construction laydown, acreage clearance, or open burning. Although additional acreage is available, the Downeast LNG Project would use only previously disturbed areas as potential construction laydown sites to avoid clearing. All affected landowners have agreed to the use of their land by the Downeast LNG Project and land lease negotiations have been completed.

Table 2.1.2-1

Summary of Land Requirements for the Proposed LNG Terminal Facilities

Facility/Use	Land Affected During Construction (acres)	Land Affected During Operation (acres)
LNG Terminal		
Terminal land based facilities a/	47.0	47.0
Pier trestle and unloading platform b/	3.6	3.6
Total	**50.6**	**50.6**

a/ Includes sendout pipeline pig launching facility inside the terminal property. Does not include acreage for three off-site temporary pipeline and terminal laydown areas. These are included in section 2.3.2.

b/ Only 0.1 acre of submerged land would be directly disturbed by the pilings.

2.1.3 LNG Terminal Facilities Construction Procedures

Downeast would construct its LNG facilities in accordance with the FERC's *Upland Erosion Control, Revegetation and Maintenance Plan* (Plan), *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) and M&NE's *Soil Erosion and Sediment Control Guidelines* (excluding appendices) used to construct the Phase II Pipeline Project in northeastern Maine. The FERC's Plan and Procedures are available for viewing on the FERC Internet website at www.ferc.gov. The M&NE Guidelines are provided in appendix H of the Environmental Impact Statement (EIS). Because Downeast has adopted the FERC Plan and Procedures, and the M&NE *Soil Erosion and Sediment Control Guidelines*, these documents will be hereafter referred to as Downeast's Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines*. Prior to construction, Downeast would prepare an Environmental Control Plan that would include its Plan and Procedures, and *Soil Erosion and Sediment Control Guidelines* as well as other applicable federal, state, and local requirements.

To prepare the terminal site for construction, areas of the onshore facilities that would be disturbed by construction activities would be stabilized with temporary erosion controls, which would be maintained until construction is complete.

The terminal site has sufficient space to allow all work to be done on-site but would require additional clearing which would reduce the buffer area around the site perimeter. In order to keep as much of the on-site vegetation as possible for use as a buffer (visual, noise, etc.), off-site areas that have been previously disturbed would be used for at least some of the fabrication and material/equipment storage for the site construction.

The near-surface competent bedrock would preclude the need for deep foundations or extensive excavations. The cut/fill balance is expected to remain on-site. The only fill that may be required to be imported is structural stone for some of the foundations and possibly the on-site roads.

Some of the larger materials needed for the LNG terminal would be delivered to the project site and constructed from working marine barges traveling from the Port of Bangor. All other required materials would be transported to the site via truck from Eastport, Maine.

Following completion of the onshore construction activities, the site would be permanently stabilized and restored through a combination of graveling, covering, seeding and landscaping to prevent erosion in accordance with Downeast's Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines*, as well as any other federal (e.g., COE) or state mandates (e.g., Maine Department of Environmental Protection [Maine DEP]).

2.1.3.1 Berthing, Vessel Unloading, and Transfer Facilities

The LNG pier trestle construction would be accomplished using a combination of "over the top" construction using land-based equipment working from the pier as it is constructed, and off-shore marine-based equipment. The "over the top" method uses a temporary (movable) construction steel frame, supported on the permanent pilings as they are installed, to support the crane in lieu of the permanent concrete beams and deck system. The crane would be moved along the pier as pilings are installed so that bottom impacts would be limited to the location of each piling. This construction method eliminates the use of barge-mounted equipment, which results in a substantial reduction of impacts on the seabed from anchoring and propeller wash. As the pier construction progresses into deeper water, the construction methodology would switch to marine-based equipment using a floating or jackup barge to install the remaining portion of the trestle and unloading platform. This construction method would minimize the use of barge-mounted equipment, resulting in a substantial reduction of impacts on the seabed from anchoring and from propeller wash.

Large diameter steel pipe piles would support the trestle and loading platform. Downeast would vibrate these piles to drive them through any surficial soils on the seabed to the top of the underlying rock where they would be seated into competent bedrock. The piles would be anchored into the bedrock using drilled rock sockets using rotary auger methods. Although the area of the pier itself would be 3.6 acres, the impact of the piles on submerged land would be 0.1 acre.

Downeast would construct the LNG mooring and breasting dolphins using floating or jackup marine-based equipment. The dolphins would either be multiple steel pipe piles supporting a large concrete cap, or a very large single steel-pipe type dolphin (monopile). These piles would be similarly driven through any surficial soils, if any, at the seabed until the top of rock is encountered, where it would then be seated and affixed to the rock using drilled rock sockets. A precast concrete form would be used to contain the cast-in-place concrete used for the remainder of the pile cap. Finally, Downeast would mount the fenders, mooring hooks and other topside equipment (railing, ladders, lights, etc.).

Once the loading platform and breasting and mooring dolphins are in-place, Downeast would erect the fabricated steel truss walkways by marine equipment to interconnect the structures for personnel access and operations.

Downeast would also incorporate the following into the design of the unloading platform:

- a pier jetty control room providing control and monitoring capabilities remotely from the Main Control Room during vessel unloading operations;
- a facility firefighting system extended to the unloading berth;

- a gangway to allow access to/from the LNG vessel for customs and immigration officials, pilots, operations personnel (including unloading supervisor), and crew members;
- gangways between the unloading platforms and berthing dolphins for use by line handlers during the berthing and unberthing of LNG vessels; and
- an LNG spill trough beneath the unloading platform and LNG transfer pipe to route any LNG spills to the terminal's LNG spill containment system. This would be designed in accordance with the requirements of National Fire Protection Association (NFPA) 59A Section 5.2.

The unloading platform and associated infrastructure include provisions to park a trailer at the pier head and to maintain a turnaround area for a small crane/truck or emergency vehicles. The trailer would be used to transport materials and equipment to/from the pier head for routine and corrective maintenance. Downeast would leave sufficient space for turnaround of a crane/truck if the trailer is left parked. Marine construction would be expected to take approximately 16 months.

2.1.3.2 LNG Storage and Vaporization Facilities

Downeast would construct the two 160,000 m^3 full containment LNG storage tanks on a ground reinforced concrete slab foundation. The ground preparation for the installation of the LNG storage tank foundation would take approximately seven months. Once the ground is prepared, installation of the foundation would take approximately four months and the LNG storage tank would take an additional 20 months to complete.

Construction of the LNG storage tank and foundation would include the following key activities:

- prepare and level the area upon which the LNG storage tank and foundation would be located;
- form and pour the concrete foundation. The tank base heating elements would be installed within the poured concrete;
- construct the outer tank carbon steel liner, install the outer tank carbon steel bottom liner on the foundation, erect the outer tank carbon steel roof liner on the outer tank bottom and erect the inner tank suspended deck and connect to the steel roof;
- raise the outer tank steel roof and suspended deck using an air lift procedure and weld to the top compression bar;
- install the tank bottom insulation;
- install the secondary tank and inner tank bottoms;
- erect the inner tank shell;
- construct the outer tank concrete walls;
- install the outer tank concrete roof;
- install and tension concrete wall pre-stress tendons;
- install tank internal accessories, such as pump columns, bottom and top fill pipework, instrument wells, purge and cool-down pipework;

- install tank external accessories, such as tank instrumentation, electrical equipment, pipework, roof platforms and access stairways;
- hydrotest the inner tank and, once complete, air dry the tank;
- final installation of the tank internal and annual space instrumentation;
- install tank insulation (once tank is completely dry);
- complete visual inspections and conduct final tank clean;
- install in-tank LNG pumps; and
- purge tank with nitrogen to a positive pressure and prepare for cool-down.

Downeast would hydrostatically test the storage tanks in accordance with American Petroleum Institute (API) Standard 620, Appendix Q.8. API Standard 620 deals with the design and construction of large, welded, field-erected low-pressure carbon steel aboveground storage tanks (including flat-bottom tanks) with a single vertical axis of revolution, and Appendix Q.8 deals with low-pressure storage tanks for liquefied hydrocarbon gases at temperatures not lower than -270°F. Downeast would fill the inner tank with approximately 28 million gallons of water. At the maximum level calculated, the water would be maintained for at least 48 hours for inspection. Downeast states that although a combination of sources may be used (water from the on-site deep well, water trucked in from a municipal or industrial supply, or Passamaquoddy Bay water), the principle source of test water would likely be from Passamaquoddy Bay. The tank would be filled and emptied as quickly as possible. After testing, the tank would be cleaned with fresh water and dried. Downeast would sample and analyze the water prior to discharge in accordance with Maine DEP requirements. If no chemicals or biocides are used in the hydrostatic test water, Maine DEP has indicated that a total suspended solids analysis would be the only analysis required.

2.1.4 LNG Terminal Operation and Maintenance Procedures

Procedures for the operation and maintenance of the import terminal would be developed to comply with the requirements of:

- 49 CFR 193, Subpart F – Operations and NFPA 59A Chapter 14 – Operating, Maintenance and Personnel Training;
- 49 CFR 193, Subpart G – Maintenance and NFPA 59A Chapter 14 – Operating, Maintenance and Personnel Training; and
- 49 CFR 193, Subpart J – Security and NFPA 59A Annex C – Security.

Downeast would train all permanent terminal operations and maintenance personnel to be qualified to operate the LNG import terminal in accordance with the requirements of 49 CFR 193, Subpart H – Personnel Qualifications and Training, and also NFPA 59A Chapter 14 – Operating, Maintenance and Personnel Training.

Operation of the Downeast LNG Project would require several utility and auxiliary systems, such as electrical power distribution, potable and service water, sanitary sewer and water treatment, storm sewer and disposal, and waste/oily water collection and treatment.

Downeast would operate the import terminal on a permanent 24 hour basis. LNG vessels would deliver LNG to a single unloading berth on the terminal's pier (see description of LNG vessels in section 2.2). The berthing terminal would be where the water depth is approximately 50 feet mean lower low water (MLLW). The arrival/mooring/unloading/departure sequence would be completed in less than 24 hours. The frequency of unloading events would vary from an average of once every 10 days during summer operation to once every 5 to 7 days during winter operation.

Upon arrival at the terminal, the ship would berth using a site-specific vessel approach system and secured with a mooring system equipped with a line monitoring system to continuously monitor tension of all mooring lines. The vessels would use onboard pumps to transfer the LNG at approximately -260°F through the unloading arms and insulated pipeline to the LNG storage tank. The marine terminal facility unloading system is designed to unload at a rate of 14,000 m^3 per hour.

LNG vessels would use water during unloading as ballast and to cool the engines generating power for the off-loading pumps and other onboard systems (e.g. hoteling). Although ballast water intake by the LNG vessel would occur during offloading of the LNG, no release of ballast water would occur within Passamaquoddy Bay. Any limited discharge of ballast water that should occur would be conducted in accordance with the Coast Guard's mandatory ballast water management program (33 CFR 151). The water used for hoteling would consist of engine cooling water that would be discharged back to Passamaquoddy Bay. A 165,000-m^3 LNG vessel would require a maximum of 55.5 million gallons of water over a 21-hour period to support engine cooling while at the pier (a maximum average rate of 540 gallons per second). The cooling water discharge rate and location would vary by LNG vessel, but typically would be perpendicular to the hull (not directed downwards) and closer to the surface than bottom, such that bottom scour would not be a concern. Downeast's Cornell Mixing Zone Expert System (CORMIX) modeling indicates that vessel engine cooling discharges would result in a maximum 26-square meter plume of water that would dissipate to a change of temperature of approximately 1°C or less warmer than ambient conditions 15 to 30 meters from the discharge source (see EIS appendix O).

During unloading, the newly added LNG would displace the vapor in the LNG storage tanks. This vapor would be returned to the vessel to maintain the pressure in the vessel's tanks. Additional BOG would be generated due to the heat added by the vessel's transfer pumps and the heat leaked into the tank and piping systems. Any BOG not returned to the vessel would be compressed by the BOG compressors and condensed in the BOG condenser. The Coast Guard does not permit routine venting of BOG to the atmosphere, thus they require LNG cargo systems used in U.S. waters be capable of maintaining the cargo for at least 21 days without exterior venting, intended to eliminate the need to vent flammable vapors while in U.S. ports.

The SCVs would be used to re-vaporize the LNG to natural gas. In each SCV, natural gas would be fired in a burner, or series of burners, submerged in a water bath. The SCV units produce their own water during normal operation. Specifically, the SCV units would produce a total of up to 109 gallons per minute (gpm) of water on a continuous volumetric design basis when the terminal is operating at peak sendout. This equates to a 24-hour discharge of between 122,400 and 156,960 gallons. During the vaporization process, this excess water would be acidic, but would not be contaminated with any foreign substances. Downeast would be required to neutralize the excess water by adding sodium hydroxide to the SCV water bath prior to its final discharge. This SCV generated water would be used in a number of ways, including firewater make-up, service water makeup, and other purposes involving resource recovery use. Downeast proposes to sell excess SCV water for offsite use to an independent party yet to be identified. Downeast states that it is in discussions with several such parties and is confident that a buyer for this water will be contracted. To ensure impacts are minimized in the event that the SCV water cannot be sold, we have recommended that Downeast file a final plan for the discharge of excess SCV water for our review and approval, prior to construction of the LNG terminal facilities. The plan should include discharge locations, rates, mitigation measures, and copies of applicable permit applications.

For the very first use of vaporizers (i.e., prior to SCV system start-up), approximately 20,200 gallons of water would be required to initialize the system. Water from the on-site wells, from commercial distributors, or a combination of both would provide the initial water volume for start-up of the SCVs. One supply well has been installed on-site and tested with a stable yield of 7.5 gpm. Existing supply wells on properties adjacent to the import terminal have yields in excess of 20 gpm. For major maintenance work requiring the water from an SCV unit to be drained, water from the in-service vaporizers would be used to fill empty vaporizer water baths.

When not in vessel unloading mode, the in-tank column-mounted LNG pumps would circulate LNG through a small diameter circulation line to the pier and back through the unloading line and to the sendout area in order to keep these piping systems cold. In sendout/vaporization mode, LNG pressure is increased to pipeline send-out pressure by High Pressure LNG pumps, before being vaporized into natural gas.

LNG would be pumped out of the LNG storage tank via in-tank, column mounted low pressure LNG sendout pumps. The LNG pressure is increased to pipeline sendout pressure by high pressure LNG pumps, before being vaporized into natural gas. Natural gas sendout would be routed by a gas pipeline distribution system to the M&NE pipeline system at the Baileyville Compressor Station for delivery to end users. Operation of the sendout pipeline is described in greater detail in section 2.3.4.

2.2 LNG VESSELS AND VESSEL TRANSITS

2.2.1 LNG Vessels

LNG vessels calling on the terminal would consist of vessels ranging in size from 70,000 to 165,000 m^3, with the potential for future vessels ranging up to 220,000 m^3. Vessels with a 145,000 m^3 storage capacity have a length of approximately 950 feet, breadth of 162 feet, and a draft of 41 feet. Typical LNG vessels are double-hulled and have containment systems consisting of the cargo tank, the secondary barrier, and insulation. LNG vessel construction is highly regulated and consists of a combination of conventional vessel design and equipment, with specialized materials and systems designed to safely contain liquids stored at temperatures of -260˚F.

2.2.2 Waterway to LNG Terminal

The proposed terminal would receive LNG from up to 60 LNG vessels per year from liquefaction plants throughout the world (e.g., Trinidad, Nigeria, Qatar, Algeria, Oman, Abu Dhabi, and Libya). Local pilots would control LNG ships during the LNG marine transit to and from the terminal. The pilots would decide whether the current and wind conditions allow safe entry to the harbor.

The Coast Guard assesses the suitability of the Head Harbor, Western Passage, and Passamaquoddy Bay Channels for LNG vessel traffic and must issue a Letter of Recommendation (LOR) for the operation of the proposed facility. In a letter to the FERC dated July 5, 2007, the Coast Guard identified additional information needed to complete and submit a Waterway Suitability Report (WSR). On January 6, 2009, the Coast Guard issued an LOR and made an assessment in its WSR that the Head Harbour Passage, Western Passage, and Passamaquoddy Bay Channels are suitable for the type and frequency of LNG vessels proposed for the Downeast LNG Project with implementation of the risk mitigation measures listed in section 4.6 of the WSR. In accordance with the WSR recommendations, the attending pilots would decide, in consultation with, and the concurrence of, the Coast Guard Captain of the Ports, whether the weather, current, visibility, and wind conditions allow safe entry to the harbor. Based on recommendations in the WSR, three to four assist tugs would escort LNG ships (depending on carrier size) to provide assistance in the unlikely event of a mechanical failure to the LNG ship or during adverse weather conditions, with one tug tethered at all times during the transit to the terminal. The WSR also recommends that authorized Coast Guard vessels escort the LNG carriers during transit. In addition, the WSR recommends that a standby tug be moored outboard of the berthed LNG vessel during its stay at the terminal.

Upon entering the Gulf of Maine, the ships could potentially take two routes to the Pilot Station at Quoddy Head. One route is east of Grand Manan Island and follows the Vessel Traffic Scheme (VTS) as shown on nautical charts. The distance from the entrance of the Gulf of Maine to the pilot station along this route is 82 nautical miles. The second route, the Grand Manan Channel Route, is west of Grand Manan Island. There is no designated shipping lane along the western route; therefore, it is left up to the Captain to choose the route based on visibility, wind, tide cycle, and other such constraints. The western route from the Gulf of Maine entrance to the pilot station is 42 nautical miles. The waterway for LNG marine traffic is shown on figure 2-4. The Coast Guard's WSR does not specifically authorize or approve one of the proposed routes.

From the pilot station near Quoddy Head, the LNG vessels would enter the harbor via the Head Harbor Passage, Western Passage, and Passamaquoddy Bay. The LNG vessels would enter the Head Harbor Passage approximately 1.5 miles from Quoddy Head at the northern end of Campobello Island. From the entry point, the LNG vessels would travel approximately 16.6 nautical miles along 13 different legs to the LNG terminal. The longest leg of the passage is in Passamaquoddy Bay and follows the United States and Canadian border.

The existing depth of the channel from Quoddy Head to the terminal varies from a minimum of 69 feet near Mill Cove to a maximum depth of 470 feet near Quoddy Head. Channel widths range between 2,600 and 13,700 feet. Water depth at the berthing terminal is approximately 45 to 50 feet MLLW, with average tidal fluctuations of approximately 18 feet. Due to the water depth and vessel draft, the use of ship's bow thrusters would be prohibited during low tide when approaching/departing the pier or while docked. The width of the channel near Mill Cove is approximately 6,080 feet which exceeds industry guidelines for turning an LNG vessel. Therefore, terminal operation would not require the dredging of a turning basin.

LNG vessels typically travel at speeds up to 19.5 knots. However, a vessel transiting to the Downeast LNG terminal would not exceed 10 knots, beginning from Grand Manan Island to the LNG terminal facility, as is reasonable for the safe operation of the vessel and its crew. The speed restriction is consistent with the NOAA Fisheries final rulemaking in 50 CFR 224 that was implemented on December 8, 2008. This ruling requires vessels greater than 65 feet in overall length to reduce speeds to 10 knots or less when traveling through North Atlantic right whale habitats. These restrictions would be in effect in the Great South Channel area of the Atlantic Ocean from April 1 to July 31; near Race Point from March 1 to April 30; and Cape Cod Bay from January 1 to May 15.

2.3 SENDOUT PIPELINE

2.3.1 Proposed Facilities

The pipeline facilities would consist of a 29.8-mile-long, 30-inch-diameter natural gas sendout pipeline, three mainline valves (MLV), a pig launcher and pig receiver[4], and natural gas metering facilities. The proposed pipeline route is depicted in figure 2-1 and EIS appendix E. Upon leaving the import terminal, the pipeline heads westward and proceeds north-northwest for 11.6 miles to just south of Calais. This segment follows approximately the right-of-way of the old U.S. Route 1, which is now inactive. From south of Calais, the route turns west for 0.75 mile and then runs north for 0.5 mile to Magurrewock Mountain. The route then proceeds on the south side of Magurrewock Mountain and crosses U.S. Route 1. The sendout pipeline would be tunneled longitudinally under the St. Croix River using a staged horizontal directional drill (HDD). The alignment would parallel the Maine Central Railroad corridor along the St. Croix River for 0.5 mile, at which point the pipeline bears south away from the railroad corridor, turns southwest, and parallels U.S. Route 1 to another portion of the existing Eastern Maine Electric Cooperative (EMEC) electrical transmission corridor. The pipeline then follows the existing EMEC electrical transmission corridor until meeting the existing M&NE right-of-way which it parallels until it's terminus at M&NE's existing Baileyville Compressor Station.

2.3.2 Sendout Pipeline Land Requirements

Downeast's construction of the proposed pipeline and related facilities would disturb about 267 acres of land, including the construction right-of-way for the 30-inch-diameter sendout pipeline, additional temporary workspaces, pipeline and terminal laydown areas, pigging facilities, access roads, and MLVs.

2.3.2.1 Sendout Pipeline Right-of-Way and Temporary Extra Workspace Requirements

The sendout pipeline construction right-of-way would generally be 75 feet wide, with 50 feet of permanent right-of-way and an additional 25 feet of construction right-of-way/temporary workspace. Downeast would require site-specific locations where wider or narrower construction right-of-way depending on proposed construction techniques and environmental sensitivities. Generally, the construction working side of the right-of-way would be 45 feet wide and the side used for spoil storage would be 30 feet wide. Downeast would narrow its

[4] A pipeline "pig" is a device used to clean or inspect the pipeline. A pig launcher/receiver is an aboveground facility where pigs are inserted or retrieved from the pipeline.

construction right-of-way to between 55 to 65 feet-wide in limited site-specific locations, such as along residential areas, existing roadways, wetlands, and within 100 feet of streambanks. Table 2.3.2.1-1 summarizes the land requirements for the proposed pipeline facilities. Additional temporary workspace of varying dimensions, adjacent to the construction right-of-way, would be required at 141 locations, primarily at road crossings, waterbodies, and wetlands.

Approximately 12 miles of the route for the sendout pipeline would be immediately adjacent to existing rights-of-way. Downeast is coordinating with EMEC on the use of their transmission line right-of-way for a portion of the sendout pipeline right-of-way. If feasible, where the

Table 2.3.2.1-1

Summary of Land Requirements for the Proposed Pipeline Facilities

Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
Pipeline		
Pipeline Right-of-Way	206.7 a/ b/	131.1 b/
Additional Temporary Workspaces	11.5	0.0
HDD Additional Temporary Extra Workspaces	7.2	0.0
Terminal Construction and Pipeline Off-Site Laydown and Storage Areas	27.5	0.0
Access Roads	10.1	10.0
Pipe Storage Area	3.4	0.0
Subtotal	**266.4**	**141.1**
Aboveground Facilities		
Valve Station	0.3 d/	0.4 e/
Pigging Receiver c/	0.5	0.3
Subtotal	**0.8**	**0.7**
Total f/	**267.2**	**141.8**

a/ Includes nominal 75-foot-wide construction right-of-way for the sendout pipeline.
b/ This table excludes areas where HDD is being proposed because these areas would not be disturbed by construction or operation of the pipeline.
c/ Acreage for the pig launching facility is included in the land requirements for the terminal in table 2.1.2-1.
d/ The total area disturbed during the valve station construction would be 0.5 acre; however, 0.2 acre overlaps the pipeline right-of-way and is included in the pipeline right-of-way acreage.
e/ This is the acreage outside the permanent pipeline right-of-way.
f/ Rounding may result in slight differences in some calculations.

pipeline would be directly adjacent to the existing right-of-way, the new pipeline would be offset about 5 to 10 feet from the outside edge of the existing utility right-of-way. The 50-foot-wide permanent pipeline right-of-way, as well as a portion of the construction right-of-way, would partially overlap the existing electric transmission line right-of way.

EMEC would construct a new electric transmission line parallel to the sendout pipeline from milepost (MP) 0.2 to MP 11.6. The new transmission line would bring electric power from EMEC's existing switchyard in Milltown to a new electric substation across from the Downeast LNG terminal.

Table 2.3.2.1-2 Where the Downeast Sendout Pipeline Would Parallel Existing Rights-of-Way			
Mileposts	**Segment Length (miles)**	**Existing Easement**	**Direction from Existing Right-of-Way**
17.7-27.2	9.5	Existing EMEC Powerline	Adjacent to the south side of the electric transmission line
27.3-29.8	2.5	Existing M&NE Pipeline	Adjacent to the south side of the pipeline

2.3.2.2 Aboveground Facilities

The sendout pipeline aboveground facilities that Downeast would construct include three MLVs and pigging and gas metering facilities. Table 2.3.2.1-1 lists the land requirements for these facilities along the sendout pipeline. The pig launching facility would be within the terminal site and require approximately 0.25 acre for both construction and operation. It is included in the 47 acres of land associated with the terminal construction and operation. The MLV at MP 17.17 would affect 0.3 acre of land outside the pipeline construction right-of-way during construction and 0.4 acre of land outside the pipeline permanent right-of-way during operation. The fenced valve station footprint would be 0.5 acre (which includes 0.2 acre of temporary pipeline right-of-way and 0.1 acre of permanent right-of-way). The pig receiving and gas metering facilities would be within the Baileyville Compressor Station property boundary at MP 29.8 and would require 0.5 acre for construction and 0.3 acre during operation.

2.3.2.3 Access Roads and Contractor Yard

Downeast would use its construction right-of-way for construction access for most of the pipeline route. Downeast would use four temporary access roads related to its proposed pipeline facilities (see table 2.3.2.1-1). Only the access road at MP 15.4 would be newly created and require clearing for a new road base. The remaining three construction access roads are existing skidder roads that were previously used for timbering activities; however, they would require upgrades prior to construction of the sendout pipeline. The width of the skidder roads are generally 15 to 25 feet, with numerous road segments exceeding 25 feet in width. The roads are compacted earth with a gravel surface and are raised above existing grade for positive drainage control. Downeast's would replace and supplement the gravel surface that has degraded over time. Small, localized sections of the skidder roads would need to be widened, but the total area for all of the access roads that requires widening would be 1 to 2 acres. Downeast would require a total of about 10 acres for constructing and upgrading the access roads. After completion of pipeline construction, Downeast would leave the road improvements in place.

Downeast has proposed three pipeline and terminal laydown areas, which would affect approximately 8 acres during the construction of the terminal and sendout pipeline (table 2.3.2.1-1). All three areas are previously disturbed by logging, construction laydown, clearing, or open burning. Following construction, Downeast would return these areas would to their pre-construction conditions.

2.3.3 Pipeline Construction Procedures

Downeast would construct its pipeline in compliance with applicable federal regulations and guidelines (e.g., U.S. Department of Transportation [DOT]), as well as state and local permit-specific conditions (e.g., Maine State Department of Transportation, Robbinston Town Road Commissioner review, etc.). Typical construction drawings for the pipeline right-of-way, road crossings, wetland protection areas, waterbody crossings, etc. are included in section 2 of the EIS. Downeast would refine its plans during detailed pipeline engineering. Federal requirements and guidelines that apply to the pipeline project component include, but are not limited to:

- its Plan;
- its Procedures;
- its *Soil Erosion and Sediment Control Guidelines* (excluding appendices) (see EIS appendix H);
- 49 CFR 192 – Transportation of Natural Gas and Other Gas by pipeline: Minimum Federal Safety Standards; and
- 18 CFR 380 – Guidelines to be Followed by Natural Gas pipeline Companies in the Planning, Clearing and Maintenance of right-of-ways and the Construction of Aboveground Facilities and Siting and Maintenance Requirements.

2.3.3.1 General Pipeline Construction

Standard pipeline construction proceeds in a manner of an outdoor assembly line composed of specific activities that make up the linear construction sequence. These operations collectively include survey and staking of the right-of-way, clearing and grading, trenching, pipe stringing and bending, welding and coating, lowering-in and backfilling, hydrostatic testing, and cleanup. In addition to standard pipeline construction, Downeast would use special construction techniques where warranted by site-specific conditions. These special techniques would be used when constructing across waterbodies, wetlands, and roads (see section 2.3.3.2 below).

Staking and Flagging

Downeast would map and flag all areas to be affected by pipeline construction in advance of actual construction activity. Important resource protection areas, such as stream crossings or wetlands, would be specifically marked and flagged as well as posted with signage. Prior to actual field work by the pipeline crews, the Environmental Inspector(s) (EIs) would guide the crew management personnel on a site-by-site review of the mapped and protected areas. The EIs would review construction restrictions and management methods designed to protect the specified areas with the pipeline crews to ensure understanding.

Clearing and Grading

Where necessary and unavoidable, Downeast would clear and rough-grade the right-of-way to specified widths Downeast would dispose of vegetative or other waste in accordance with applicable permit conditions. Erosion controls would be installed immediately after initial clearing and disturbing of an area’s surface soils.

Trenching

Downeast would determine the trench excavation widths and depths prior to the start of pipeline construction. Typically, excavation would be limited to allow for 3 feet of cover as required by

49 CFR 192. Generally, the trench would be about 6 feet deep (for a minimum of 3 feet of cover over the pipe) and between 10 to 25 feet wide. Downeast would excavate the pipeline ditch with either a rotary trencher or track-mounted backhoe.

Downeast would conduct topsoil segregation in accordance with its Plan, agency requirements, or landowner specifications to minimize the mixing of topsoil with subsoil.

Pipestringing, Bending, and Welding

Pipeline crews would "string" the pipe sections along the right-of-way. Side-booms or other suitable equipment would off-load the pipe sections from trucks and place them in the stringing area. The pipe sections would then be lined up end to end to allow for welding and bending into continuous lengths. Pipe welding would occur in accordance with API Standard No. 1104 (most current revision). Downeast would conduct quality assurance/quality control in accordance with 49 CFR 192.

Lowering-in/Backfill

Downeast would lower coated and inspected pipe lengths into prepared trenches and cover with a soil material padding that acts as a buffer between the pipeline and the backfill. The remainder of the trench would be backfilled with suitable soil material. Ideally, the material that was excavated for the trench would be used as backfill. Where the material is not suitable as backfill, such as large rock, imported material would be used. The trench may be over-backfilled to allow for additional settlement over time. After installation of the pipe, Downeast would internally clean it of loose impediments that may have been left over from the installation process by using compressed air-driven manifolds.

Hydrostatic Testing

After cleaning and prior to service, Downeast would test the pipeline would in accordance with 49 CFR 192. The test consists of placing the pipeline under hydrostatic pressure to verify its structural integrity for its design pressure load. If a leak or break in the pipeline were to occur during testing, Downeast would repair and retest that section of pipe until the DOT specifications are met. Approximately 6.1 million gallons of water would be required for hydrostatic testing of the entire 29.8-mile, 30-inch-diameter sendout pipeline. Downeast has stated it would test the sendout pipeline in more than one segment, allowing for reuse of some of the water and lowering the quantity needed. The length of the test segments would dictate the water volume needed. Downeast has identified the Baileyville Utility District as the source of hydrostatic test water through a direct connection to the fire hydrant system. Downeast would discharge the hydrostatic test water to an unnamed creek at MP 17.5 or to the Baileyville Utility District sewer system at a rate of 1,400 to 2,800 gpm. The Maine DEP must permit the discharge of hydrostatic test water used to test the integrity of oil and gas facilities in Maine. In addition, hydrostatic test waters that fall under the jurisdiction of the Maine DEP and that would be discharged into waters of the state would require a permit under the Maine Pollutant Discharge Elimination System (Maine PDES), as regulated by the Clean Water Act. Downeast must also obtain the appropriate Section 401 and 404 Water Quality Certifications prior to discharge of hydrostatic test water into surface waterbodies.

Cleanup and Restoration

Following backfill, Downeast would final-grade and restore all work areas to pre-construction contours, as closely as possible, and collect all construction debris along the right-of-way. Downeast would install permanent erosion control structures, such as slope breakers, during final grading, in accordance with its Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines*. Downeast would restore the work areas within one week after the trench has been backfilled and graded. In addition, restoration of wetlands would be conducted in accordance with any COE permit conditions. Downeast would restore or repair any private property damage from construction, such as fences, field roads, and driveways, as necessary.

Downeast would revegetate disturbed areas using native seed mixtures in accordance with recommendations of the local office of the Natural Resources Conservation Service or as requested by the landowner. Downeast would monitor all construction work areas for the success of revegetation and restoration. Downeast would conduct inspections after: (1) initial placement of regrading, stabilization, and reseeding; (2) at the beginning and latter parts of the first full growing season; and (3) during the second growing season. Restoration and revegetation success evaluations would be based on predetermined criteria established with the various agencies and expressed as conditions in relevant permits and approvals.

2.3.3.2 Special Construction Techniques

Special construction techniques would be used when work is required in and around waterbodies, wetlands, roads and utilities, agricultural land and residences, and in areas where rock blasting may be required.

Wetlands and Waterbodies

Downeast's surveys indicate that 39.1 acres of wetlands would be affected by construction of the proposed project. Permanent or operational impacts would affect 23.3 acres of wetlands[5]. This acreage may be reduced during final routing design to avoid or minimize the extent of wetland crossings. To minimize impacts on wetlands, Downeast would follow its Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines* and minimize the amount of time that constructing in wetland areas. Areas with wetland soils that are inundated or saturated to the surface would be excavated from wooden swamp mats to minimize the disturbance of wetland soils. In wetlands that have firm substrates or are unsaturated, Downeast would segregate the top 12 inches of wetland soil over the trenchline by piling it in a ridge adjacent to the pipeline trench. Leaving gaps in the spoil piles at appropriate intervals would ensure circulation and drainage of water. Downeast would assemble the pipeline in upland staging areas that are outside of the right-of-way.

In accordance with Downeast's Procedures, it would locate wetland construction staging areas least 50 feet or more from the wetland edge. If the setbacks are not possible due to construction limitations, Downeast would request a variance from its Procedures and *Soil Erosion and Sediment Control Guidelines*.

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[5] These acreage impacts include the Downeast LNG terminal, sendout pipeline, access roads, and aboveground facilities.

Typically, the additional temporary work area for wetland crossings would be 25 feet wide by 200 feet long. However, work areas would only rely on the minimal size required for staging and accessing stockpiled soils and equipment. Larger workspaces may be required for large wetland crossings. Downeast would maintain vegetative buffers between the work areas and the wetland during construction.

Downeast would protect water quality while working in wetlands and other waterbodies by:

- keeping construction materials, fuels, etc., 100 feet or more from of any stream or wetland system, except under limited, highly controlled circumstances;
- refueling construction equipment in upland areas 100 feet or more from any stream or wetland system, except under limited, highly controlled circumstances; and
- washing construction equipment outside of any wetland or waterbody.

The proposed LNG terminal would impact one waterbody and the sendout pipeline would cross 22 waterbodies. Downeast would cross streams and rivers as quickly as possible to minimize structural or water quality impacts. Table 2.3.3.2-1 indicates Downeast's proposed pipeline installation method for each of the waterbody crossings. The construction methods and associated information listed are subject to change based on specific field conditions, easement agreements, and permit conditions. Downeast would cross most streams using conventional backhoe-type equipment and dry, open-trench methodology. The dam-and-pump method is a dry-crossing technique that uses pumps to isolate water from the construction work area. This method is Downeast's preferred waterbody crossing technique. Downeast would cross 9 of the 22 waterbodies using the HDD crossing method. Downeast would conduct preconstruction geotechnical evaluations to ensure that HDD drilling operations as proposed are feasible. Downeast has also stated that it would prepare and submit site-specific HDD crossing and contingency plans prior to construction. We believe that such plans are a necessary component for completing an HDD with the least environmental impact. The HDD method involves boring a pilot hole beneath the waterbody to the opposite bank and then enlarging the hole with one or more passes of a reamer until the hole is the necessary diameter. A prefabricated pipe segment is then pulled through the hole to complete the crossing. A successful HDD generally results in no impact on the waterbody being crossed. For this reason, HDD is a preferred crossing method for major waterbodies, especially those that are sensitive or where there are sensitive environmental issues. HDD is not technically feasible in some types of geologic environments such as glacial till, and it requires larger staging areas than other stream crossing methods.

In the event that an HDD is unsuccessful and the HDD crossing has to be abandoned, Downeast would fill the HDD pilot hole with an environmentally safe fluid (typically a mixture of bentonite clay and water) that would match the consistency of the surrounding subsurface. Downeast has indicated that as a final contingency, it would install the pipeline at an alternate location that would avoid a crossing of the St. Croix River.

Table 2.3.3.2-1

Waterbodies Crossed by the Proposed Pipeline

Town	MP	Waterbody	State Water Quality Classification a/	Waterbody Width/Crossing Length (linear ft) b/	Crossing Method	Stream Type	Fishery Type c/
Robbinston	0.8	Eastern Stream	B	25 / 25	Dam and Pump	Perennial	Cold-water
Robbinston	2.0	Unnamed stream	B	4 / 4	Dam and Pump	Intermittent	Warm-water
Robbinston	4.3	Unnamed stream (outlet of Keene Lake)	B	9 /1,165	HDD	Perennial	Cold-water
Calais	6.7	Flowed Land Ponds	B	12 / 141	HDD	Perennial	Cold-water
Calais	7.7	Unnamed stream (inlet to Flowed Land Ponds)	A	7 / 7	Dam and Pump	Perennial	Cold-water
Calais	8.6	Tributary of Beaver Brook (upstream of Flowed Land Ponds)	A	10 / 2,629	HDD	Perennial	Cold-water
Calais	12.3	Unnamed stream	A	3 / 3	Dam and Pump	Intermittent	Warm-water
Calais	14.1-14.2	Magurrewock Stream Outlet	A	528 / 792	HDD	Perennial	Cold-water
Calais/ Baring	14.2-15.3	St. Croix River	C	3,000 / 5,829	HDD	Major river	Cold-water
Baring	15.6	Unnamed stream	A	3 / 3	Dam and Pump	Intermittent	Warm-water
Baring	15.6	Unnamed stream	A	3/3	Dam and Pump	Intermittent	Warm-water
Baring	16.9	Conic Stream	A	3 / 3	Dam and Pump	Perennial	Warm-water
Baring	17.2	Unnamed stream	A	3 / 3	Dam and Pump	Intermittent	Warm-water
Baring	17.6	Unnamed stream, (tributary of St. Croix River)	A	3 / 3	Dam and Pump	Perennial	Warm-water
Baring	17.8	Unnamed stream, (tributary of St. Croix River)	A	8 / 1,227	HDD	Perennial	Warm-water
Baileyville	18.1	Unnamed stream, (tributary of St. Croix River)	A	4 / 1,227	HDD	Perennial	Cold-water
Baileyville	18.4	Stony Brook	A	18 / 18	Dam and Pump	Perennial	Cold-water
Baileyville	21.3	Wapsaconhagen Brook	A	37 / 37	Dam and Pump	Perennial	Cold-water
Baileyville	22.5	Unnamed stream (tributary of Wapsaconhagen Brook)	A	4 / 4	Dam and Pump	Perennial	Warm-water
Baileyville	25.2	Anderson Brook	A	15 / 2,622	HDD	Perennial	Cold-water
Baileyville	25.8 (3 crossings	Unnamed stream	A	4 / 4, 4 / 4, 4 / 4	Dam and Pump	Intermittent	Cold-water
Baileyville	28.9	Headwater tributary to Anderson Brook	A	8 / 1,000	HDD	Intermittent	Cold-water

a/ State Designation - Based on Title 38 MRSA §465
A - 2nd highest classification. Must be of such quality that they are suitable for the designated uses of drinking water after disinfection; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as natural.
B - 3rd highest classification. Must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as unimpaired.

Table 2.3.3.2-1							
Waterbodies Crossed by the Proposed Pipeline							
Town	**MP**	**Waterbody**	**State Water Quality Classification a/**	**Waterbody Width/Crossing Length (linear ft) b/**	**Crossing Method**	**Stream Type**	**Fishery Type c/**

C – 4th highest classification. Must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as a habitat for fish and other aquatic life.

b/ Waterbody width determined from Downeast's field measurements and aerial photograph interpretation.

c/ Fishery types were assigned based on habitat functionality observed during field assessment of proposed Pipeline crossings. Fishery habitat suitability assigned to waterbodies not sampled in the field were based on aerial photograph interpretation and Maine DIFW fish stocking records.

HDD = horizontal directional drill

In the event an inadvertent release of drilling fluid is accessible, Downeast would take the following appropriate measures:

- contain the drilling fluid with straw bales such that it cannot migrate across the ground surface;
- excavate a small sump pit at the location and provide a means for the fluid to be returned to either the drilling operations or a disposal site (i.e., pump through a hose or into a tanker); and
- continue drilling operations and maintaining the integrity of the containment measures and monitoring the fluid returns to ensure that no surface migration occurs.

Should the inadvertent release of drilling fluid occur at a location that is inaccessible or along the bed of a waterbody and into the water, Downeast would use the following appropriate procedures:

- ensure that all reasonable measures have been taken to re-establish fluid circulation, such as reducing fluid pressure during pilot hole drilling or vary drilling fluid properties in order to reduce frictional drag and pressure;
- continue drilling with the minimum amount of drilling fluid as required to penetrate the formation and successfully install the pipe; or
- if the amount of the release exceeds that which can be suitably contained with hand placed containment barriers, small collection sumps would be used for fluid removal and recycling.

The EIS appendix E has been updated to include site-specific construction diagrams for each proposed HDD crossing showing the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction.

To cross minor streams of less than 10 feet that contain coldwater or significant warmwater fisheries, a temporary dam and flume pipe would be installed prior to trenching to divert stream flow over the construction area and allow for dry trenching of the stream crossing. Downeast would store trench spoils behind silt and sedimentation control structures. Pipe strings would be fabricated on one bank and moved into the trench by pulling pipe sections across the stream bottom to the opposite bank, floated across the stream, or carried into place. Downeast's

Procedures and *Soil Erosion and Sediment Control Guidelines* would be used to adopt procedures for different waterbody crossings that may be encountered.

Where necessary, Downeast would install temporary construction equipment crossings across waterbodies taking into account highest expected flows during construction. Construction equipment crossings would be carefully installed after clearing to minimize streambed disturbance and downstream siltation. Where culverts are used, Downeast would minimize scouring through engineered devices. Construction equipment would be limited to one pass and not permitted to drive through the waterbody after establishing crossings. Downeast would remove the construction equipment crossings once pipeline installation and construction restoration are completed.

To facilitate pipeline construction across waterbodies, Downeast would need construction staging areas adjacent to the waterbody to assemble and fabricate the length of pipe necessary to complete the crossing. These staging areas are in addition to the standard construction right-of-way and Downeast would locate them at least 50 feet from the stream bank where technically feasible.

Rock Blasting and Rugged Topography

Downeast would use one of the following techniques to remove rock encountered during construction based on rock hardness, fracture susceptibility, and expected volume of the material: conventional backhoe excavation, dozer ripping and backhoe excavation, use of a backhoe hammer and backhoe excavation, or blasting and backhoe excavation. Blasting would be performed by licensed professionals according to strict guidelines designed to control energy release.

Downeast's sendout pipeline would not cross any areas of steep side slopes requiring special construction techniques; however, construction along moderate side slopes would be necessary. Permanent trench breakers (e.g., sandbags) would be installed in trenches over and around the pipe in areas with potential slope erosion.

2.3.3.3 Aboveground Facilities

Downeast would install three MLVs and two pigging facilities for the sendout pipeline. The LNG terminal site would contain the MLV and pig launching facility at the start of the sendout pipeline. The MLV at MP 17.17 would affect 0.3 acre of forested land outside the construction right-of-way and 0.4 acre outside the permanent right-of-way during operation. The pig receiving and gas metering facility would be at MP 29.8 in Baileyville and would affect 0.5 acre of developed land outside of the pipeline construction right-of-way and 0.3 acre of developed land outside the permanent right-of-way during operation.

2.3.4 Pipeline Operation and Maintenance Procedures

Downeast would inspect all aboveground equipment, permanent erosion controls, and revegetation during pipeline and right-of-way patrols. In addition, Downeast would address any conditions that could prohibit the safe operation of the pipeline with respect to right-of-way maintenance (fallen trees, excess vegetation, trespasser obstructions or damage, etc.). Any soil erosion or excess sedimentation along the pipeline right-of-way would be reported to appropriate environmental management personnel. Downeast would identify corrective measures concurrently with the inspection and implement these measures, as needed, in a timely manner.

Maintenance would include periodic seasonal mowing of the permanent right-of-way, and vegetation control around aboveground facilities. Downeast would maintain vegetation in the 50-foot-wide permanent right-of-way on an approximate three to five year basis in uplands. Vegetation control would be limited in wetland and riparian areas to the selective clearing of trees and shrubs greater than 15 feet in height within 15 feet of the pipeline. In addition, Downeast would maintain a 10-foot-wide corridor centered on the pipeline in an herbaceous state on an annual basis. Permanent rights-of-way associated with the pipeline system would be maintained in accordance with Downeast's Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines*, as well as any additional requirements (e.g., COE, local towns, Maine DEP, etc.). The use of herbicides is not proposed for vegetation maintenance.

As stated previously, Downeast would conduct regularly scheduled pipeline surveys as part of the pipeline system maintenance activities and safety programs.

2.4 CONSTRUCTION SCHEDULE

Downeast anticipates that construction of the Downeast LNG Project would take about 35 months, starting with terminal site work and foundation preparation for the LNG storage tanks. Once the tank foundations are in place, work would begin on tank construction, terminal buildings, and the marine terminal. The LNG storage tank construction would take approximately 30 months from the start of site work. Construction of the other terminal facilities would take about 18 months with marine construction taking approximately 16 months. Downeast would construct the sendout pipeline construction in 9 to 12 months.

The construction contractors would observe and comply with all applicable federal, state and local laws, ordinances, and regulations that apply to the conduct of the work. A list of environmental permits and approvals that have been received to date, as well as those that are anticipated by the project is found in table 1.3-1 of the EIS.

2.5 ENVIRONMENTAL COMPLIANCE INSPECTION AND MITIGATION MONITORING

Downeast would implement environmental compliance and monitoring requirements from its Plan, Procedures, and *Soil Erosion and Sediment Control Guidelines* during construction of the LNG terminal and sendout pipeline. Downeast would also incorporate compliance and monitoring requirements from federal, state, and local permits obtained for its project.

In accordance with its Plan and Procedures, Downeast would conduct environmental training for construction and contractor personnel before construction and periodically during construction. Downeast would employ at least one EI for construction of the LNG terminal, and at least one EI for construction of the sendout pipeline and MLVs. The EIs would ensure construction activities comply with the conditions of the FERC Certificate, and all other applicable federal, state, and local permits. The EIs would report to the Lead Downeast Inspector, but have independent status and stop-work authority in the event of a noncompliance issue that requires corrective action.

In addition, the FERC would conduct independent inspections of the project throughout construction and restoration, to ensure compliance with the Commission's environmental conditions.

2.6 FUTURE PLANS AND ABANDONMENT

Downeast does not foresee abandonment of the proposed facilities prior to the expiration of its design life (25-plus years). If abandonment were to occur, Downeast has committed to the Town of Robbinston to restore the property parcel to a non-industrial condition by the removal of terminal components and land restoration actions. This commitment would be evidenced by a reclamation bond or similar financial guarantee and has been stipulated in the executed Downeast-Town of Robbinston Agreement. Downeast would also have to file an application with the FERC to abandon the LNG facility and sendout pipeline. A determination would then be made as to the best method of abandonment (e.g., removal or abandon in-place of the pipeline) along with the restoration of the right-of-way, in consideration of landowner preferences.

3.0 IDENTIFICATION OF EFH IN THE ACTION AREA

The Downeast LNG Project would be within the management jurisdiction of the NEFMC. The EFH designations within the Northeast Region (Maine to Virginia) include EFH for a number of species in various life stages. EFH potentially affected by the proposed project were identified through the use of NOAA Fisheries maps consisting of 10-minute by 10-minute square coordinate grids or quadrants. The available data for species likely to occur within Passamaquoddy Bay included a 10-minute square with the following coordinates: North 45° 50.0' N; East 66° 50.0' W; South 44° 40.0' N; West 67° 00.0' W (NEMFC 1998; NOAA Fisheries 1998). This area is also shown on figure 3-1. Additional 10-minute by 10-minute squares were used for comparison and area correlation in this EFH assessment, including the coordinates of North 45° 00.0' N; East 67° 00.0' W; South 44° 50.0' N; West 67° 00.0' W, and North 44° 50.0' N; East 67° 00.0' W; South 44° 40.0' N; and West 67° 10.0' W. These additional areas, as well as specific habitats available in or near the project area were cross-referenced with known habitat requisites of EFH species and life stages to help predict the likelihood of those species using the Downeast LNG Project area.

Our review of the aforementioned maps and appropriate literature indicates that the waters of Passamaquoddy Bay contain designated EFH for various species and life stages of managed species under the MSA, including 29 species of finfish, 3 species of shellfish, and 4 species of skate. HAPC for Atlantic salmon has also been designated within watersheds around the Passamaquoddy Bay area (NOAA Fisheries 2005).

Based on the review of available literature, we believe that the project would have no effect on 22 of these species because the project would not be within the known range of the species, the project would not impact habitat for the species, or EFH has not been designated for the species in question (see table 3-1). These 22 species are not addressed further in this assessment.

The remaining 14 species, and their associated life history stages, with designated EFH that are identified as occurring or having the potential of occurring within the Downeast LNG Project area are listed in table 3-2 and discussed below.

The EFH for each identified managed species, as well as the specific habitat requirements for each life stage are identified and discussed below. Project-related changes that could result in potential adverse effects on these species at various life stages as a result of the construction and operation of the proposed Downeast LNG Project are also presented.

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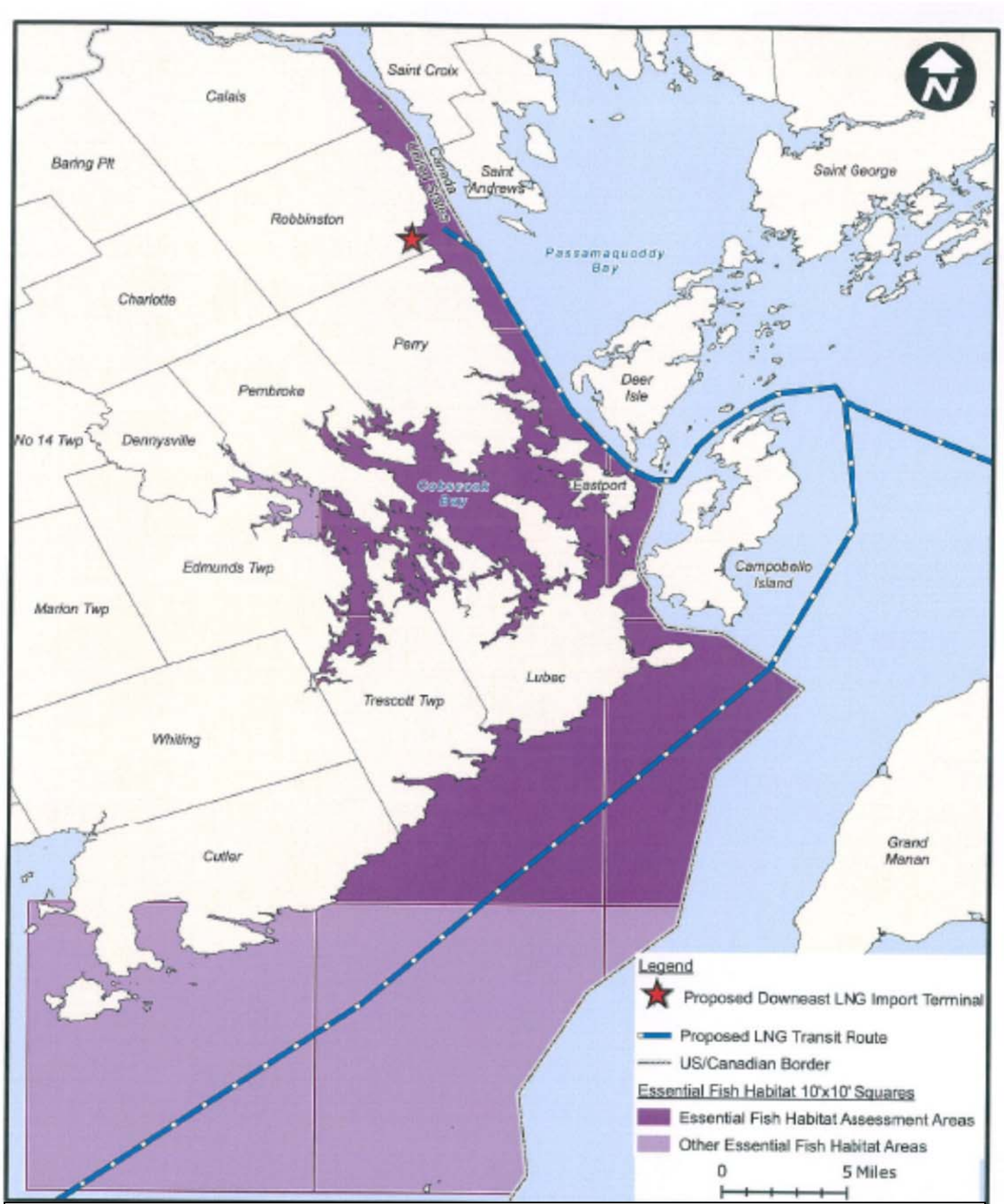

Figure 3-1
Downeast LNG Project
Essential Fish Habitat Areas

Table 3-1

Essential Fish Habitat Designated by NEFMC for Species Identified as Occurring in the Waters of Passamaquoddy Bay, Maine, Eliminated from Further Consideration for the Downeast LNG Project

Species	Reason for Elimination from Further Consideration	Determination of Effect
Barndoor skate (*Dipturus laevis*)	EFH not designated for this species within the project area	No Effect
Black sea bass *(Centropristus striata)*	Relative abundance is rare within the project area	No Effect
Bluefish *(Pomatomus saltatrix)*	Relative abundance is rare within the project area	No Effect
Butterfish *(Peprilus triacanthus*); also called Atlantic butterfish	Relative abundance is rare within the project area	No Effect
Haddock *(Melanogrammus aeglefinus)*	Relative abundance is rare within the project area	No Effect
Little skate (*Leucoraja erinacea*)	EFH not designated for this species within the project area	No Effect
Long finned squid *(Loligo pealei)*	Relative abundance is rare within the project area	No Effect
Monkfish *(Lophius americanus)*	Relative abundance is rare within the project area	No Effect
Ocean quahog *(Artica islandica)*	Relative abundance is rare within the project area	No Effect
Offshore hake *(Merluccius albidus)*	Relative abundance is rare within the project area	No Effect
Redfish *(Sebastes fasciatus)*	Relative abundance is rare within the project area	No Effect
Scup *(Stenotomus chrysops)*	Relative abundance is rare within the project area	No Effect
Short finned squid *(Illex illecebrosus)*	Relative abundance is rare within the project area	No Effect
Smooth skate (*Malacoraia senta*)	EFH not designated for this species within the project area	No Effect
Spiny dogfish *(Squalus acanthias)*	Relative abundance is rare within the project area	No Effect
Summer flounder *(Paralicthys dentatus)*	Relative abundance is rare within the project area	No Effect
Surf clam *(Spisula solidissima)*	Relative abundance is rare within the project area	No Effect
Thorny skate (*Amblyraja radiata*)	EFH not designated for this species within the project area	No Effect
Tilefish *(Lopholatilus chamaeleonticeps)*	Relative abundance is rare within the project area	No Effect
Winter skate (*Leucoraja ocellata)*	EFH not designated for this species within the project area	No Effect
Witch flounder *(Glyptocephalus cynoglossus)*	Relative abundance is rare within the project area	No Effect
Yellowtail flounder *(Pleuronectes ferruginea)*	Relative abundance is rare within the project area	No Effect

Sources: Jury et al.1994; David K. Stevenson, Ph.D. (personal communication)

3.1 EFH SPECIES PROFILES

The principal information for species accounts presented herein are primarily derived from species synopses presented by NEFMC (1998), which include descriptions of essential fish habitat and conditions, as well as maps of the distribution of each life history stage. A brief summary of the individual managed species and life stage requirements, sediment preference, and comments on behavior, and previously recorded observance in the general region is provided below. A complete description of the geographic distribution and biological requirements of the various life stages of each species are presented in *NOAA Fisheries Technical Memoranda, Essential Fish Habitat Source Document: Life History and Habitat Characteristics* series.

American plaice (*Hippoglossoides platessoides*)

The four life stages of the American plaice have been identified as potentially occurring within the project area. Eggs are laid between March and May within waters where the range of water temperature is 34°F to 54°F, in depths between 100 and 300 feet, and a wide range of salinities.

Table 3-2

Essential Fish Habitat Designated by NEFMC for Species Identified as Occurring or Having the Potential of Occurring Within the Downeast LNG Project Area

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
American plaice *(Hippoglossoides platessoides)*	C	C	C	C	C
Atlantic cod *(Gadus morhua)*		C	C	C	
Atlantic halibut *(Hippoglossus hippoglossus)*	ND	ND	ND	ND	ND
Atlantic herring *(Clupea harengus)*		A	H [e/]	H	
Atlantic mackerel *(Scomber scombrus)*			C	C	
Atlantic salmon *(Salmo salar)*			C	C	
Atlantic sea scallop *(Placopecten magellanicus)*	A	A	A	A	A
Ocean pout *(Macrozoarces americanus)*	A	A	A	A	A
Pollock *(Pollachius virens)*		C	A	C	
Red hake *(Urophycis chuss)*			C	C	
Silver hake *(Merluccius bilinearis) also called Whiting*			A	A	
White hake *(Urophycis tenuis)*			A	A	
Windowpane flounder *(Scopthalmus aquosus)*	C	C	C	C	C
Winter flounder *(Pleuronectes americanus)*	H	H	H	H	H

Sources: NOAA Fisheries 2013, NEFMC 1998, Jury et al. 1994
A = abundant. H = highly abundant. C = common.
ND = no relative abundance data reported, but life history stage is known to occur.
Blank Field = the particular life history stage is not known to occur based on Jury et al. 1994.

Larvae emerge between April and June when water temperatures range from 39°F to 57°F and water depths between 100 and 427 feet and a wide range of salinities. Juveniles can be found between March and November in waters ranging between 39°F and 61°F at depths between 148 and 492 feet, and in waters having a salinity of 31 to 35 ppt.

Adults are normally found within waters that range in temperatures from 37°F to 59°F, depths between 148 and 574 feet and a wide range of salinities (but generally between 31 to 35 ppt). Mature adults spawn in March through May at temperature ranges of 37°F to 43°F. This species prefers soft substrates, fine sand and/or gravel. Short seasonal migrations are due to temperature changes (Johnson 2004). All life stages for this species (see table 3-2) are considered common within the Downeast LNG Project Area.

Atlantic cod (*Gadus morhua*)

Four life stages of Atlantic cod are expected to occur within Passamaquoddy Bay and surrounding areas. Habitat preference for cod eggs include sea surface temperatures below 54°F, water depths less than 361 feet, and a salinity average between 32 and 33 ppt.

Larvae are found in bottom habitats with a substrate of cobble or gravel from January through June. Juveniles are found in pelagic waters at temperature ranges of 39°F to 52°F, but may tolerate broader temperatures in the range of approximately 37°F to 64°F. Depths ranging from 98 to 230 feet and a salinity range of 31 to 35 ppt are preferred by cod larvae. Generally, juvenile Atlantic cod are typically found inhabiting waters with temperatures below 68°F, depths from 82 to 246 feet, and a salinity range between 30 to 35 ppt. Juveniles are more abundant in areas with macroalgal canopies (Lough 2004).

Adults occur in bottom habitats with a substrate of rocks, pebbles, or gravel during late autumn through winter, although their temperature tolerance range is between 34°F and 63°F (preferably below 50°F), at depths from 33 to 492 feet, and a wide range of oceanic salinities with a tolerance range of 30 to 35 ppt. The majority of spawning occurs offshore, although there is evidence that spawning can also take place inshore.

Eelgrass (*Zostera marina*) beds are also an important habitat for the juvenile life stages of the Atlantic cod. Eelgrass beds are considered Significant Wildlife Habitat by the Maine Department of Inland Fisheries and Wildlife (Maine DIFW), with beds greater than 25 acres providing high value (Maine Department of Marine Resources [Maine DMR] webpage). Although no specified or protected eelgrass beds were identified by the EFH as occurring specifically in the Passamaquoddy Bay area, based on site-specific surveys, eelgrass beds have been identified along the Maine coastline, including areas within the Downeast LNG carrier transit route (figure 3-2). In addition, eelgrass mapping completed by Maine DMR in 2010 identified eelgrass within Mill Cove that was not present during previous mapping efforts in the 1990s (http://www.maine.gov/dmr/rm/eelgrass/changemaps/11.pdf) (figure 3-3). The mapped eelgrass occurs in shallow water and at the closest point would be approximately 2,500 feet from the end of the pier where LNG vessels and support tugs would operate. Because of this distance, operation of LNG vessels and support vessels within the waterway would not impact mapped eelgrass. However, the proposed pier would cross about 350 feet of mapped eelgrass.

Atlantic halibut (*Hippoglossus hippoglossus*)

Atlantic halibut spawn offshore and it is unlikely that eggs or larvae would be found within the Downeast LNG Project area. Juvenile and adult life stages for this species have the potential to be found within the Downeast LNG Project area; however, while these life stages are known to occur, data on relative abundance of this species within the Downeast LNG Project area is lacking (see table 3-2). Atlantic halibut eggs are generally observed between late fall and early spring, in waters with temperatures between 39°F and 45°F, depths less than 2,296 feet, and salinities less than 35 ppt. Juveniles tend to emigrate from nursery areas between three and four years of age. They prefer sand and coarse sediment (Cargnelli et. al. 1999a). Adult Atlantic halibut tend to occupy waters with temperatures below 56°F, depths from 328 to 2,296 feet, and salinities between 30 and 35 ppt. Potential seasonal and spatial variability of conditions that may be associated with this species have been acknowledged by NEFMC.

Atlantic herring (*Clupea harengus*)

Larvae and juvenile Atlantic herring likely occur year round within the waters of the Passamaquoddy Bay as they are generally very abundant. Atlantic herring eggs are demersal and primarily dispersed on rock, pebbly or gravelly bottoms, and on shell substrates and clay to some extent. Spawning occurs from late August through November in coastal waters and shoals from 13 to 300 feet and is known to occur in the western Passamaquoddy Bay (Bigelow and Schroeder 1953, 2002). Atlantic herring larvae are generally found in pelagic waters in the Gulf of Maine between August and April, with sea surface temperatures below 60.8°F, depths from 164 to 295 feet, and salinities around 32 ppt. Larvae and juveniles can tolerate a wide range of temperatures (below 50°F), depths (from 49 to 443 feet), and salinities (from 26 to 32 ppt). Atlantic herring

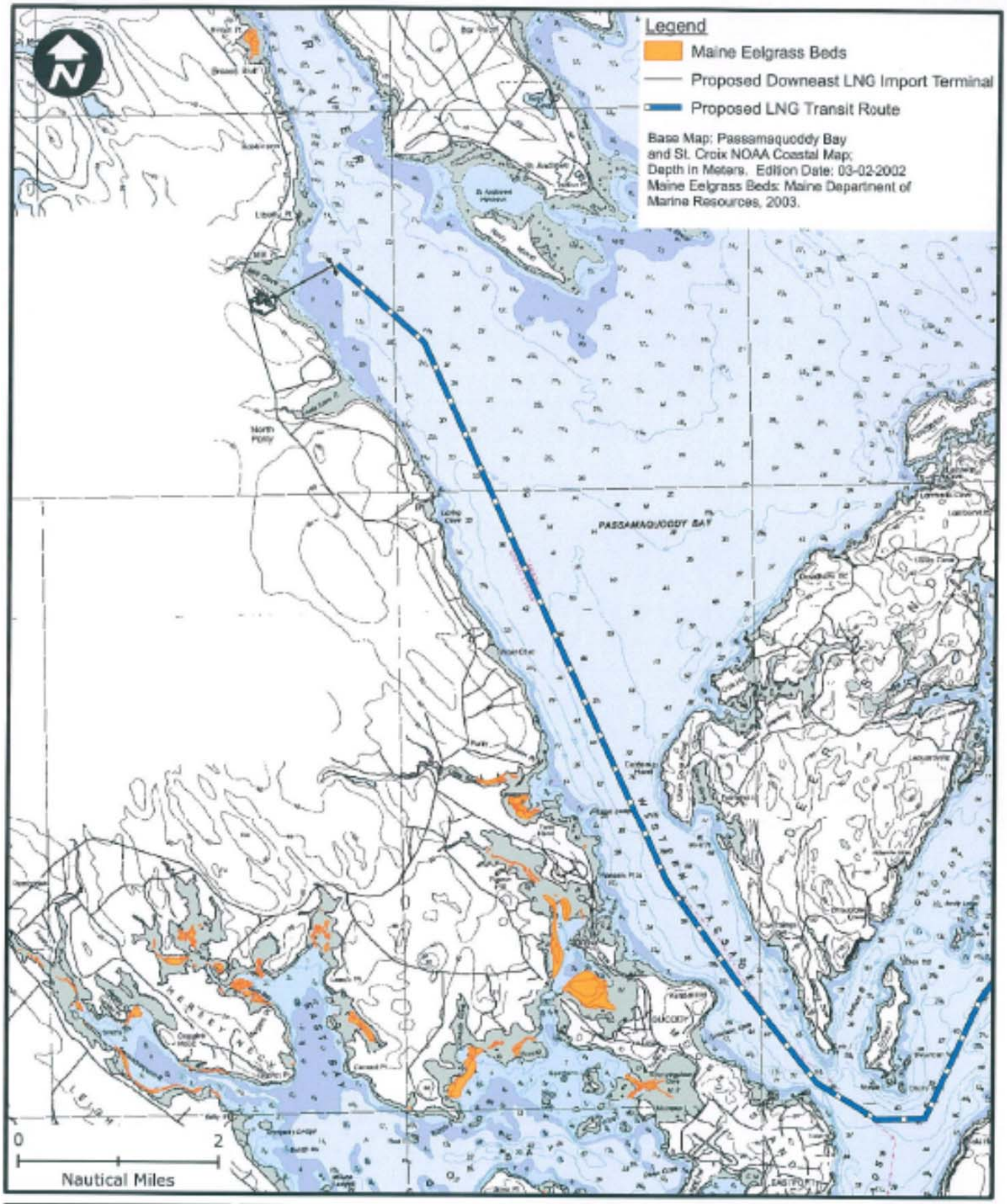

Figure 3-2
Downeast LNG Project
Maine Eelgrass Beds

Figure 3-3
Downeast LNG Project
Project Site Eelgrass

larvae have been reported to be the most common ichthyoplankton species in Passamaquoddy Bay (Fife 2006) and represent almost 90 percent of the fish larvae collected during the Maine DMR's Fall 2001 monitoring within the region. On-site sampling for ichthyoplankton was conducted by Downeast LNG from October, 2006 through February, 2008. Analysis of this data indicates that in the Downeast LNG Project area Atlantic herring was the dominant fish larvae in October 2006 and October 2007, coinciding with autumn spawning occurrences in the Gulf of Maine (Bigelow and Schroeder 1953, 2002).

Atlantic herring juveniles are generally found in bottom habitats of pelagic waters. Adults are also found in waters with temperatures below 50°F depths ranging from 65 to 427 feet, and salinities above 28 ppt. Adult Atlantic herring spawn on offshore ledges and shoal areas. Adults are considered to be more of a pelagic fish. Therefore, this life stage of the species is unlikely to occur within the Downeast LNG Project area (Stevenson and Scott 2005).

Atlantic mackerel (*Scomber scombrus*)

Atlantic mackerel are primarily offshore pelagic fishes, but schools of young fish occasionally enter bays and harbors in search of food between April and October, but primarily in the summer, after which they go offshore. Their importance as a recreational fishery is greater than that as a commercial fishery (Bigelow and Schroeder 1953, 2002).

Atlantic salmon *(Salmo salar)*

Egg and larval lifestages tend to prefer bottom habitats with a gravel or cobble riffle, with water temperatures below 50°F, and clean, fresh water. Juvenile, or parr, prefer similar clean fresh water habitats, with water depths of 4 to 24 inches, and substrate types interspersed with deeper riffles or pools. Parr can tolerate water temperatures below 77°F, and water velocities between 12 and 36 inches per second. Parr develop into smolts and this lifestage requires downstream access to the ocean, where they enter a pelagic lifestage. Adult salmon require access to their natal streams, as well as access to spawning grounds in clean fresh water, with temperatures below 50°F, depths 12 to 24 inches, and velocities around 24 inches per second. Non-spawning adults are also pelagic, ranging throughout the Gulf of Maine and areas along the continental shelf off New England with temperatures below 73 °F. Juvenile and adult Atlantic salmon are considered common within Passamaquoddy Bay (see table 3-2), and transient individuals of these life stages are likely to occur in the Downeast LNG Project area.

According to the *Report to Congress*, EFH for Atlantic salmon is described as all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other waterbodies in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut identified as EFH, (NEFMC 1998; NOAA Fisheries 2005; NOAA Fisheries 2007a). Habitats currently being used by the species should be considered essential, including estuaries and embayment areas that support "abundant," "common," or "rare" levels of Atlantic salmon adults. However, the NEFMC also states that, "The rivers from which Atlantic salmon have been extirpated were not selected as EFH on the presumption that it would be extremely unlikely that these rivers will again support Atlantic salmon without artificial supplementation or stocking" (NOAA Fisheries 2005). In the Downeast LNG Project area, the Passamaquoddy Bay and the St. Croix River contain suitable EFH habitat for the Atlantic salmon. The St. Croix River is also designated as a Habitat Area of Particular Concern for Atlantic salmon. Downeast conducted detailed stream evaluations during August 2006, using survey protocols established by the Maine Atlantic Salmon Commission [Maine ASC]. Its stream survey results are summarized in attachment B of the Biological Assessment. Based upon this information, Downeast did not identify any potential Atlantic salmon spawning areas that would be crossed by the proposed sendout pipeline. Additionally, the proposed crossings of stream reaches were not identified as having suitable habitat conditions for Atlantic salmon adults, parr, or smolts.

The Gulf of Maine also contains Distinct Population Segments (DPS) for Atlantic salmon. DPS for this species within the Gulf of Maine encompasses all remnant populations of naturally reproducing Atlantic salmon, from downstream Kennebec River to the mouth of the St. Croix River. There are eight known watersheds that are utilized by the DPS Atlantic salmon, either currently and/or historically, located in the Downeast and mid-coast sections of Maine. These rivers include the Dennys River, East Machais River, Machais River, Pleasant River, Narraguagus River, Ducktrap River, Sheepscot River, and Cove Brook (FWS 2006). The Dennys River watershed is crossed by the Downeast LNG Project. These distinct habitats support the only naturally spawning populations of Atlantic salmon, and additionally are highly susceptible to numerous anthropogenic impacts; therefore, they are considered HAPC.

Atlantic sea scallops (*Placopecten magellanicus*)

Atlantic sea scallops tend to be abundant in the region throughout their life cycle. Sea scallop eggs are found in bottom habitats and are thought to occur where water temperatures are below 63°F. Spawning occurs from May through October, and is probably more tidally related than temperature related (Hart and Chute 2004). Scallop larvae tend to be found in pelagic waters and bottom habitats with a substrate of gravelly sand, shell fragments, and pebbles, or on various red algae, hydroids, amphipod tubes, and bryozoans. Sea scallop larvae are found where sea surface temperatures are below 64°F and salinities are between 16.9 ppt and 30 ppt. Sea scallop juveniles are found in bottom habitats with a substrate of cobble, shells, and silt where temperatures are below 59°F, and water depths range from 59 to 360 feet. Adult sea scallops are also found in bottom habitats with a substrate of cobble, shells, coarse/gravelly sand, and sand, with water temperatures below 70°F, water depths from 59 to 360 feet, and salinities above 16.5 ppt. Atlantic sea scallops are recognized as an important commercial species.

Ocean pout (*Macrozoarces americanus*)

Ocean pout eggs are laid in gelatinous masses, and can be found on hard bottom habitats sheltered nests, holes, or crevices within bay areas. Due to low fecundity, egg masses are guarded by either the female or both parents. Relatively few eggs (< 4,200) are laid, and egg development can take two to three months during late fall and winter. Water conditions in which ocean pout eggs can be found include temperatures below 50°F, depths less than 164 feet, and salinities that range from 32 to 34 ppt. Larval ocean pout are found in waters with sea surface temperatures below 50°F, depths less than 164 feet, and salinities greater than 25 ppt, generally during late fall through spring. Juvenile ocean pout prefer smooth bottom near rocks or algae, and water conditions with temperatures below 57°F and depths less than 263 feet. Conditions that are preferred by adult ocean pout include water temperatures below 59°F and depths less than 360 feet. Juveniles are found at salinities greater than 25 ppt, while adults prefer 32 to 34 ppt (Steimle et al. 1999b). Spawning generally occurs between September and October at temperatures between 43°F to 48°F, and a salinity range of 32 to 34 ppt. The juvenile and adult life stages of this species have the potential of occurring within waters of the Downeast LNG Project area.

Pollock (*Pollachius virens*)

Pollock eggs and larvae are found in pelagic waters with sea surface temperatures less than 63°F, and salinities between 32 and 32.8 ppt. Pollock eggs are found in water depths of 98 and 885 feet, whereas larvae are found in water depths between 33 and 820 feet. Pollock eggs are often observed from October through June, and larvae are often observed from September to July. Juvenile Pollock tend to prefer bottom habitats with aquatic vegetation or a substrate of sand, mud or rocks, and water conditions such as temperatures below 64°F, depths from 0 to 820 feet, and salinities between 29 and 32 ppt. Adult pollock can also be found on hard bottom habitats, and tolerate a temperature range of 32°F to 57 °F, depths from 49 to 1,197 feet, and salinities between 31 and 34 ppt. Adults are migratory and spawn offshore, and are not as selective to bottom type (Cargnelli et al. 1999b). The juvenile and adult life stages of this species have the potential of occurring within waters of the Downeast LNG Project area.

Red hake (*Urophycia chuss*)

Red hake eggs are found in surface waters of the Gulf of Maine, and are most frequently seen during the months from May to November. Preferred conditions for red hake eggs include sea surface temperatures below 50°F along the inner continental shelf with a salinity less than 25 ppt. Red hake larvae are also found in surface waters from May through December, at temperatures generally below 66°F, in depths less than 656 feet, with a salinity greater than 0.5 ppt. Red hake juveniles are found in bottom habitats with a substrate of shell fragments, including areas with an abundance of live scallops. Water temperatures below 61°F, depths less than 328 feet and a salinity range from 31 to 33 ppt are preferred by red hake juveniles. Adult red hake are generally found in bottom habitats in depressions with a substrate of sand and mud; water temperatures below 54°F are preferred, as well as depths from 33 to 427 feet, and salinity within the range of 33 to 34 ppt. Juveniles and adults are migratory, and spawning occurs offshore (Steimle et al. 1999a). It is possible that juvenile and adults of this species may occur in the Downeast LNG Project area.

White hake (*Urophycis tenuis*)

White hake eggs are most often observed in August and September in surface waters, whereas the larval stage tends to be found in pelagic waters also during August and September. Larvae emerge between May and September when temperatures are between 50°F to 64°F. There are two stages of juvenile white hake: the pelagic stage and the demersal stage. White hake juveniles in the pelagic stage are most often observed from May through September within pelagic waters. Demersal stage juveniles tend to occupy bottom habitats with seagrass beds or a substrate of mud or fine-grained sand. These juvenile stages are found in waters with temperatures between 46°F and 66°F and depths from 16 to 738 feet. White hake adults are found in bottom habitats with a substrate of mud or fine-grained sand, as well as water temperatures of 41°F to 57°F and depths from 16 to 1,066 feet. White hake adults lay their eggs in August-September at temperatures between 44°F to 68°F. The species prefers fine grained sediments and migrates seasonally (Packer et al. 1999). As shown in table 3-2, juvenile and adult life stages of this species have the potential to occur in the Downeast LNG Project area.

Eelgrass beds are also an important habitat for the larval stages of the White hake. Eelgrass beds are considered Significant Wildlife Habitat by the Maine Department of Inland Fisheries and Wildlife, with beds greater than 25 acres providing high value (Maine DMR webpage). Although no specified or protected eelgrass beds were identified by the EFH as occurring specifically in the Passamaquoddy Bay area, based on site-specific surveys, eelgrass beds have been identified along the Maine coastline, including areas within the Downeast LNG carrier transit route (figure 3-2). In addition, eelgrass mapping completed by Maine DMR in 2010 identified eelgrass within Mill Cove that was not present during previous mapping efforts in the 1990s. The mapped eelgrass occurs in shallow water and at the closest point would be approximately 2,500 feet from the end of the pier where LNG vessels and support tugs would operate. Because of this distance, operation of LNG vessels and support vessels within the waterway would not impact mapped eelgrass. However, the proposed pier would cross about 350 feet of mapped eelgrass.

Silver hake, or whiting (*Merluccius bilinearis*)

Silver hake are also referred to as whiting. Whiting eggs and larvae are found in surface waters with temperatures below 68°F and water depths between approximately 164 and 492 feet. Whiting eggs can be observed all year, although peaks are seen June through October, and peaks of whiting larvae can be observed from July through September, although they are present year round. Whiting juveniles occupy all substrate types in bottom habitats, and are found where water temperatures are below 70°F, depths between 65 and 885 feet, and salinities greater than 20 ppt. Adult whiting also occupy bottom habitats composed of all substrate types, where water temperatures are below 72°F and at depths between 98 and 1,066 feet. It is possible that juveniles and adults of this species may occur in the Downeast LNG Project area.

Windowpane flounder (*Scophthalmus aquosus*)

Windowpane flounder eggs are found in surface waters with temperatures ranging between 43°F and 68°F and water depths less than 230 feet. Windowpane flounder larvae generally occupy pelagic waters with sea surface temperatures less than 68°F and water depths less than 230 feet. Juvenile windowpane flounder inhabit bottom habitats with substrates consisting of mud or fine-grained sand. Juveniles are common from June through October at temperatures ranging between 39°F to 61°F (below 77°F), depths from 3 to 328 feet, and salinities between 5.5 to 36 ppt. Windowpane flounder adults are found in bottom habitats with a substrate of mud or fine-grained sand, water temperatures below 80°F, depths from 3 to 246 feet, and salinities between 5.5 to 36 ppt. It is possible that all life stages of this species occur in the Downeast LNG Project area.

Winter flounder (*Pseudopleuronectes americanus*)

Winter flounder is the most common shoalwater flounder in the Gulf of Maine. Winter flounder eggs are found in bottom habitats with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, as well as the inshore areas of the Gulf of Maine. Flounder eggs tend to occur in waters with temperatures less than 50°F, water depths less than 16 feet, and salinities between 10 and 30 ppt; eggs are often observed from February to June. Winter flounder larvae are found in pelagic and bottom waters of Georges Bank and the inshore areas of the Gulf of Maine, where sea surface temperatures are less than 59°F, depths less than 20 feet, and salinities between 4 and 30 ppt. Winter flounder larvae are often observed from March to July. Two stages of Winter flounder juveniles have been identified. Winter flounder young-of-the-year occupy bottom habitats with a substrate of mud or fine grained sand, within waters where the temperature is below 82°F, depths from 0.3 to 33 feet, and salinities ranging between 5 and 33 ppt. The second juvenile stage of winter flounder is the Age 1-plus juvenile found in inshore areas in waters with temperatures below 77°F, depths from 3 to 164 feet, and salinities between 10 to 30 ppt. Adult winter flounder occur in bottom habitats including estuaries with a substrate of mud, sand, and gravel, with water temperatures below 77°F, depths from 3 to 330 feet, and salinities between 15 and 33 ppt. Spawning winter flounder adults are found in waters with temperatures below 59°F, depths less than 20 feet (except on Georges Bank where they spawn as deep as 262 feet), and salinities between 5.5 and 36 ppt. Spawning occurs in January through May, the optimal temperature being 38°F to 42. °F and optimal salinity 11 to 33 ppt. Temperature dependent migration occurs, although food availability may also be a factor (Pereira et al. 1999). It is possible that all life stages of this species may occur in the Downeast LNG Project area.

4.0 POTENTIAL ADVERSE EFFECTS OF THE PROPOSED ACTION

Any probable or potential effect that reduces the quality and/or quantity of EFH is considered to be an "adverse impact" as defined by NOAA Fisheries (50 CFR 600.910[a]). An adverse impact may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, or reduction in species fecundity), and site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The construction and operation of the Downeast import terminal would have direct and indirect environmental consequences on the various life stages of finfish and invertebrate species with designated EFH along the marine traffic route, as well as in the area of the proposed LNG import terminal and pier during construction and operation. Construction impacts would include the potential for benthic and marine vegetation disturbance (e.g., habitat alteration, sedimentation, turbidity) in the pier footprint, impacts on water quality, noise disturbances, and entrainment of fish eggs and larvae during hydrostatic testing. Operational impacts would include entrainment of fish eggs and larvae during water withdrawals for vessel cooling, hoteling, ballast water intakes, and fire suppression pump testing, as well as alteration of hydrodynamic processes in the Downeast LNG Project area. Each species that would potentially be affected by anticipated construction and operation impacts is discussed below.

4.1 CONSTRUCTION IMPACTS

Construction of the LNG terminal would involve the installation of the pier and berthing facilities within Mill Cove. Construction activities would affect organisms with designated EFH in various life stages near the proposed project area. Construction activities may alter Mill Cove's benthic habitat and communities including EFH and associated species. Installation of the pier would disturb and occupy 4,885.5 square feet (0.1 acre) of bay floor removing a selected portion of the benthic community immediately underlying and/or adjacent to each pile. In this area of impact, sedentary and less mobile species may be permanently affected and those with little or no mobility would suffer some mortality. However, it is assumed that adjacent benthic species would repopulate the disturbed areas as well as the pile structure itself following these activities, resulting in a temporary effect with little long-term impact on the overall population level. Pier shading is addressed below under operation impacts.

Downeast's installation of the pier and berthing facilities may alter flow in Mill Cove and result in the scouring or accumulation of bottom sediments immediately adjacent to the pier. In an extreme case, if flow is sufficiently deflected, scouring may also occur some distance from the pier. However, we do not expect this impact to create noticeable changes in the physical bathymetry of the Cove or the greater Passamaquoddy Bay area.

Pier construction would also contribute to water quality degradation through increased turbidity which could result in impacts on EFH and designated species. The resuspension of sediments during pier installation activities, including propeller wash from construction vessels and pile driving, could have negative impacts on benthos, fishes, and EFH. Specifically, increased turbidity could result in reduced light penetration with some reduction in primary productivity as well as affect the ability of sight feeders to locate prey. Turbidity can also cause an increase in biological oxygen demand resulting in decreased dissolved oxygen concentrations available to fish in and around the affected area. Low dissolved oxygen concentrations can also negatively affect organisms that are an important resource base in fish habitat. In addition, filter feeding organisms may experience clogging from construction-related suspended sediment. Finfish may also experience similar gill clogging effects. Shellfish larvae are particularly sensitive to the increase of suspended material in the water column. Downeast would employ specific construction methods (e.g., vibropiling and "over the top" pier construction) and best management practices (BMPs) for minimizing/localizing turbidity (e.g., limiting need for construction vessels that may suspend shallow sediments with propeller wash by utilizing "over the top" construction methods), for this project to minimize the disruption of sediments. Further, Downeast does not propose any dredging to deepen the berth. As such, it is anticipated that the amount of material that is mobilized during construction would be localized and significantly less than other activities routinely conducted in the Bay, such as scallop dredging. In addition, due to the significant amount of mixing in the area, we do not anticipate that sediments would be disturbed in a manner significantly different than that resulting from normal storm conditions in the area and typical of the Mill Cove shallows. Specific impacts on shellfish populations are also expected to be minor as these organisms inhabit an extensive range and are known to recolonize disturbed areas quickly. Impacts on finfish are also expected to be minor and temporary as those displaced by construction activities are anticipated to return once construction is complete. Furthermore, while Passamaquoddy Bay is considered EFH for lifestages of American plaice, Atlantic cod, Atlantic halibut, Atlantic herring, Atlantic mackerel, and Atlantic salmon, the pier would be within the mixing zone of the estuary with salinities between 0.5 and 25.0 ppt (NOAA, Fisheries 1985) and at depths less than 60 ft (18 m). Impacts on EFH for these species and lifestages is unlikely in the vicinity of the terminal site. The area offshore of the proposed pier is not EFH for adult and spawning adult American plaice, juvenile and adult Atlantic cod, and all lifestages of Atlantic halibut due to the relatively shallow depth of the Pier (<60 ft [<18 m]), and relatively fresh water near the terminal site.

Based upon investigations conducted by Downeast, there are several areas of contaminated sediments within the proposed footprint of the facilities that could also adversely impact surrounding water quality. These contaminants include arsenic and nickel which exceeded the Threshold Effect Levels benchmarks (it could not be determined if the biologically available form of arsenic was present); one dioxin and one furan compound with reported results lower than the analysis calibration limit; and fluoranthene which occurred in concentrations that exceeded the screening benchmark provided in the Screening Quick Reference Tables (SQuiRTS) published by NOAA (Buchman 1999). Despite the presence of contaminated sediments, we believe impacts on water quality resulting from the disturbance of these sediments during construction would be temporary and minor. Downeast would employ a vibropiling technique for pier installation. No dredging or in-water blasting is proposed. It is expected that the mobilization of these sediments would not be substantially different from normal bottom disruption caused by storm events.

The construction and installation of the pier and berthing facilities would also generate underwater noise, which may temporarily reduce fish usage in and around the site. Impacts on demersal and pelagic EFH species may occur during the construction of the pier, primarily due to noise associated with any use of a vibratory hammer or rock socket drilling. The type and intensity of sounds produced depends on a number of factors including the type and size of the pile, substrate firmness, water depth, and the type and size of the vibratory hammer (NOAA Fisheries 2005). During typical-impact type pile driving, the sound frequency generated upon impact is within the range of 9kHz. Injury to fish as a result of pile driving can include internal hemorrhaging, swim bladder ruptures, physical injury, auditory tissue damage, and behavioral changes (NOAA Fisheries 2005; Hastings and Popper 2005). Construction noise at very high decibel levels could also result in tissue damage in benthos and in some instances mortality. In addition, sound pressure waves passing through the water or sediments may create a localized avoidance response in those benthos that are sensitive to disturbance or may result in periodic alteration/cessation of feeding activity. Also if drilling and/or vibropiling were to occur during anadromous fish migrations (Atlantic salmon, Atlantic herring, etc.), the avoidance of the nearshore areas could restrict migrating fish to deepwater areas that are less suitable for some species, which could in turn increase the susceptibility of some smaller species to predation. In a filing with the Commission on May 3, 2013 Downeast stated that based on current design and engineering the project could be constructed using only vibratory hammering for pile driving, and committed to the singular use of vibratory hammering for the installation of piles. Use of vibratory hammering, rather than impact hammering, would reduce underwater noise. Estimates for use of the vibratory hammer at the terminal indicate that the maximum noise would be 190 dB re 1 μPa or below within 5 meters of the hammer, 180 dB dB re 1 μPa between 5 meters and 11 meters, and 170 dB re 1 μPa between 11 meters and 60 meters. Given the use of vibratory hammering, we believe impacts on aquatic organisms near the project area construction activities would be temporary and minor. Mobile organisms are likely to avoid using the area during construction, causing temporary displacement; however, suitable habitat for displaced organisms is not lacking in Passamaquoddy Bay. Unlike fish with swim bladders, most benthic invertebrates are unlikely to be susceptible to tissue damage from most common construction noise levels as the energy would pass through their bodies. To further minimize impacts, Downeast LNG has agreed to the following conditions, required by NOAA Fisheries:

- All LNG vessels, or vessels involved with the terminal construction, navigating Grand Manan Channel would establish communications with Marine Communications Traffic Services Center “Fundy Traffic” upon entering the channel, or when crossing a line drawn between Cutler, Maine and the southwestern tip of Grand Manan Island, or approximately 44.6^{o} north latitude. Vessels departing the Downeast LNG terminal via the Grand Manan Channel would establish communications prior to getting underway and maintain communications until south of southwestern tip of Grand Manan Island.
- All vessels over 65 feet (19.8 meters) involved with construction, or future operations of the Downeast LNG terminal would comply with ship strike rules (50 CFR Part 224.105) in US waters. In addition, from July through October, vessels would slow to 10 knots upon entering Grand Manan Channel, on a line drawn between Cutler, Maine and the southwestern tip of Grand Manan Island, or approximately 44.6^{o} north latitude. Vessels departing the Downeast LNG terminal from July through October, via the Grand Manan Channel, would not exceed 10 knots until south the previously specified latitude.
- All vessels over 65 feet (19.8 meters) navigating the Bay of Fundy Traffic Separation Scheme (BOF TSS) that are involved with construction, or future operations of the Downeast LNG terminal would slow to 10 knots upon northwesterly course adjustment near 44.5^{o} north latitude from July through October. Vessels bound for the Downeast LNG terminal would remain at 10 knots or slower until their arrival at the terminal, or until control is relinquished to a tug. Vessels departing the Downeast LNG terminal from July through October, via the BOF TSS, would not exceed 10 knots until after making the southwesterly course adjustment near 44.5^{o} north latitude.

- Downeast stated that based on current design and engineering the project could be constructed using only vibratory hammering for pile driving, and committed to the singular use of vibratory hammering for the installation of piles. The effectiveness of this mitigation would be determined as described below.
- Underwater noise levels would be mitigated for to ensure that the extent of the 150 dB re 1µPa Root Mean Squared isopleth (i.e., the level of underwater noise believed to cause behavioral modification in sturgeon and other diadromous species) does not prevent passage of species within the affected body of water. While individuals may be displaced from, or avoid, the ensonified area, there must always be a zone of passage where noise levels remain below 150 dB re 1µPa Root Mean Squared.
- Downeast would determine the effectiveness of mitigated pile driving by modeling sound levels throughout the ensonified area and provide an updated isopleth map to NOAA Fisheries prior to the issuance of a concurrence letter.
- During construction, Downeast LNG would record PEAK sound pressure level and calculate Cumulative Sound Exposure Level (CSEL) and Root Mean Squared (RMS) from the sound pressure level waveform and report results to NOAA Fisheries staff on a daily basis.
- During rock socket drilling and pile driving, Downeast LNG would monitor sound pressure level with hydrophones and a digital recorder capable of operating at a minimum of 600,000 samples per second for a minimum of one second, with an adjustable trigger level, and a range of at least 30 psi. Based on protocol for measuring in-water acoustic fields and natural noise attenuation of 3-6 dB per doubling of distance, a minimum of three locations will be monitored, located approximately 10, 20, and 40 meters from the sound source.
- A post-project report, confirming completion of construction and the successful application of all terms and conditions of this permit, must be submitted within four (4) weeks of project completion. Submit post-project reports to NOAA Fisheries and to FERC.
- Due to the water depth and vessel draft, the use of ship's bow thrusters are prohibited, subject to conflicting Coast Guard or Pilot requirements necessarily imposed for navigational safety and/or security, during low tide when approaching/departing the pier or while docked.
- Downeast would conduct preconstruction geotechnical evaluations to ensure that HDD drilling operations as proposed are feasible. Downeast has also stated that it would prepare and submit site-specific HDD crossing and contingency plans prior to construction.
- Downeast should conduct project-specific eelgrass mapping within Mill Cove to determine the presence and extent of eelgrass within areas that could be affected by the Project within Mill Cove. Results of the eelgrass mapping should be incorporated into compensatory mitigation planning, as needed. Downeast should file the results of the eelgrass mapping, and any resulting mitigation plan for potential impacts on eelgrass including records of consultation with Maine DMR and NOAA Fisheries regarding

mitigation, with the Secretary for review and written approval by the Director of OEP, prior to construction.

Hydrostatic testing of the two proposed LNG storage tanks would be conducted using a total of approximately 28 million gallons of water. Testing of the LNG storage tanks would consist of water primarily from Passamaquoddy Bay; however, some portion of the water used could come from other sources, including water from on-site groundwater wells and storage or water trucked in from a municipal or industrial supply. Entrainment and impingement of fish and other aquatic organisms, as well as fish eggs and larvae could occur during withdrawals of hydrostatic test water from the bay. Downeast would minimize entrainment and impingement by regulating the intake rate and by the use of screens on intake hoses. Downeast is currently proposing the use of a #200 mesh filter during intake of hydrostatic test waters. Downeast would also coordinate with federal and state agency personnel regarding the scheduling of testing to minimize potential conflicts with seasonal/life-cycle periods of important aquatic resources including EFH species. FERC staff would review all supplemental information when filed, and would finalize consultation with resource agencies regarding the scheduling of testing.

The use of mechanized equipment during construction has the potential to result in releases of petroleum and other chemicals into the environment. A spill of oil and hazardous materials into Passamaquoddy Bay could be toxic to fish. To reduce the potential for direct spills, Downeast would develop and follow a site-specific, agency approved Spill Prevention, Control and Countermeasure Plan (SPCC Plan) that incorporates BMPs to prevent and/or minimize accidental material release into the environment. This plan would provide Downeast’s measures for controlling, cleaning up, and reporting chemical releases.

4.2 OPERATION IMPACTS

Operation of the import terminal would affect EFH and designated EFH species as a result of vessel operation within the area. The hydraulic conditions created by vessels transiting in a waterway may result in hydraulic disturbances primarily due to propeller wash, varying water depths, vessel draft, and other factors (e.g., propeller speeds). Marine vegetation, specifically eel grass, is particularly sensitive to degradation in water quality from activities such as development, sediment loading, and boating activity which can shade, smother, or remove eelgrass and its habitat. Benthic community habitats may also be adversely affected by sediments and/or turbidity generated by transiting and docking LNG vessels. Loss of these habitats could result in impacts on EFH species which rely on them to support various life stages along the transit route. Mapped eelgrass near the LNG terminal occurs in shallow water and at the closest point would be approximately 2,500 feet from the end of the pier where LNG vessels and support tugs would operate. Because of this distance, operation of LNG vessels and support vessels at the terminal would not impact mapped eelgrass. Because of the substantial depths of water associated with the transit route that would be used by LNG vessels to and from the terminal, and the extreme tidal fluctuations in the region, whereby local organisms are expected to be acclimated to high-flow, turbid waters, the potential for increased sediment suspension or turbidity is not expected as vessels travel back and forth in the navigation zone. Reduced vessel speeds during approach and departure to the Downeast LNG terminal are also expected to reduce potential for sediment suspension or erosion due to reduced wave action and propeller wash. Due to the water depth and vessel draft, the use of ship’s bow thrusters would be prohibited during low tide when approaching/departing the pier or while docked. Additionally, docking operations for the LNG vessels would be assisted by tugs, which have drafts that place their propellers considerably above the seafloor at the end of the pier, thereby minimizing propeller wash effects on bottom sediments.

Modeling was conducted for the Boston Harbor Navigation Improvement Project to assess the effect of ship passage on the resuspension of surficial sediments in federal ship channels (COE 1995). The modeling assumed a channel depth of 45 feet and varying vessel drafts from 12 to 42 feet. The study concluded that silt, the predominant grain size of the surficial sediments assessed in the model, can be resuspended by currents as slow as 0.65 feet/second. The study also found that bottom velocities generated by cargo vessels passing at slow speeds through the harbor can exceed this value up to 1,312 feet astern of the vessel and that tugs can generate bottom velocities above this value up to 656 feet astern of the vessel. Turning areas were found to be particularly susceptible to resuspension of sediments as the result of ship passage. The results indicated that the surficial sediments in the federal ship channels and berth areas are subject to resuspension during virtually every ship passage. However, the results also indicated that ship induced bottom velocities dissipate rapidly following the passage of the ship and that sediments resuspended by these currents settle back to the substrate after being transported relatively short distances (COE 1995).

Following completion of the Boston Harbor Navigation Improvement Project, the COE conducted additional studies to monitor the effect of deep-draft vessel movement on the resuspension of bottom sediments (SAIC 2000, 2001). These studies used static and mobile monitoring techniques to evaluate the impact of the passage of an LNG vessel (Matthew) on bottom sediment resuspension from the confined aquatic disposal cells along a portion of the Mystic River downstream of the Distrigas LNG facility as well as material resuspended from other parts of the channel.

These studies demonstrate that sediment resuspension due to passage of deep-draft vessels can mobilize bottom sediments, but the volume of sediment resuspended is relatively small and the sediments are not transported far from their original locations. Vessel movements within a navigation channel result in short-term water quality effects that generally dissipate within 1 hour of the vessel passing any particular point along the channel.

The potential for resuspended sediment to impact fish eggs and larvae depends upon the species, the concentration of particles, and the duration of exposure. Demersal eggs, such as those of winter flounder, may be partially or completely covered by fine-grained sediments as they settle back to the bottom. This may slow the exchange of oxygen between the water and egg and, therefore, slow development or cause eggs to experience higher mortality rates (Wilbur and Clarke 2001). Exposure to high levels of suspended solids (between 200 and 500 mg/L) for durations of less than 24 hours has been shown to reduce feeding rates in some fish larvae (Breitburg 1988). In general, however, exposure to increased turbidity for periods of less than one day appears to have little measurable effect on pelagic fish eggs and larvae (Kiorboe et al. 1981; Wilbur and Clarke 2001).

Based on the results of the Boston Harbor studies, the increased suspended solids levels resulting from the proposed LNG vessel passage could result in reduced feeding rates for some fish larvae in the immediate vicinity of the pier. However, we expect there would be minimal impact from elevated suspended solids levels on most pelagic fish eggs and larvae because suspended solids concentrations should return to background conditions within one hour or less of ship passage. Additionally, propeller wash due to normal operation of tugs, escort vessels, and LNG vessels would not be expected to increase turbidity in the vicinity of the pier because the sediments in this area appear to be cohesive, soft marine clays. Based on the initial monitoring in the Mystic River, the sediment plume did not rise above mid-water elevations (i.e., the plume was not observed at the water surface, and monitoring equipment indicated a maximum water column elevation of about 20 feet above the channel bottom). The dimensions of the monitored plumes in Boston Harbor suggest that impacts on demersal fish eggs and larvae by remobilized sediments would likely be limited.

Once completed, the bottom of the pier deck and unloading platform would be approximately 3,862-feet-long by 37-feet-wide, and stand about 38.1 feet above the surface of the water at MLLW. These facilities could shade approximately 6.6 acres of intertidal, subtidal, and open-water habitat. Included in the area impacted by shading would be about 0.6 acre of eelgrass as mapped by Maine DMR. We have recommended that Downeast conduct project specific mapping to determine potential presence and extent of eelgrass and need for mitigation for potential impacts, including from shading during operation (see section 4.4.2.2 of the final EIS). Shading may result in the alterations of species in the immediate project area by providing enhanced habitat for predatory species or other species that avoid intense direct sunlight during the day and seek seclusion. Increased shading may also have negative impacts on marine vegetation whose growth is limited by light availability. However, despite these potential impacts the pier is relatively narrow and would be constructed a sufficient height above the water as to have minor shading affects. In addition, while the pier may serve as a detractor to various species due to shading, the pier pilings themselves would provide new attachment surfaces for various marine species. We expect *Fucus* and *Ascphyllum* to colonize an area of the pilings from approximately 2 feet above MLLW to zero feet MLLW. *Rhodymenia, Laminaria,* and *Alaria* would be expected to colonize a zone from zero to 20 feet below MLLW. *Agarum* would be expected to colonize the pilings below 20 feet MLLW (Hanic 1974). While the pier may reduce biological productivity of marine vegetation due to either shading or lighting, the pier pilings themselves would provide new attachment surfaces for various marine species.

Artificial lighting would also be used along the pier that could result in effects on marine organisms. To ensure safety, lighting of the pier is under the jurisdiction of the Coast Guard. Downeast would work with the Coast Guard to establish a lighting plan that would both meet Coast Guard safety standards and minimize the impacts associated with artificial lighting on marine organisms to the extent practicable.

Once constructed the pier would constitute a physical intrusion, in terms of distance, into Passamaquoddy Bay. Placement of support structures in areas of flow could result in altered hydrodynamic processes (Harbeneau and Holley 2001; Dyhouse et al. 2003). For instance, local current patterns could be influenced by the effect of the pier pilings/supports deflecting flow or lowering its velocity which could result in the alteration of localized normal sediment deposition patterns. Pilings/supports associated with the pier could also result in increased localized turbulence as flow passing through the structure is disturbed (Dyhouse et al. 2003). In the most extreme case, this turbulence may lead to a localized mixing of the water column that was formerly temperature and salinity stratified. Other potential direct consequences could include shifts in the distributions of benthic fauna requiring specific grain-size classes immediately adjacent to the pier. In addition, organisms with a planktonic larval stage that are dependent on transport processes facilitated by currents could be subject to localized shifts in recruitment patterns (Gaines and Bertness 1992). However, given the extreme tidal fluctuations of the area, we do not expect installation of pilings/supports to create noticeable changes in hydrodynamics of the Cove or the greater Passamaquoddy Bay area. Additionally, careful design of the pier and attendant structures would ensure that on- and off-site bathymetric changes and associated impacts are minimized. As such, we believe changes to hydrodynamic processes in the Cove and Bay are not likely to result in functional community shifts.

No seawater would be used in the regasification of the LNG. Water withdrawals and discharges would only occur for vessel engine cooling, ballasting, hoteling, and fire suppression pump testing while at the berth, and weekly testing of the Emergency Firewater System pumps. Water withdrawals to support these systems would result in impacts on designated EFH species. It is anticipated that the size of vessels servicing the terminal would range from 125,000 m^3 up to 165,000 m^3. To maintain a constant draft while berthed at the pier, LNG vessels would require between 53,683 m^3 (small capacity 125,000 m^3 vessel) and 64,759 m^3 (large capacity 165,000 m^3 vessel, including 165,000 m^3 diesel vessel) of seawater ballast. This ballast water would be withdrawn from the surrounding area for a duration of approximately 12 hours per 21-hour cargo unloading period. Vessels would also require between 10,500 m^3 (large capacity 165,000 m^3 diesel vessel) and 168,000 m^3 (steam-driven large capacity 165,000 m^3 vessel) of water to support engine cooling and between an estimated 10,500 m^3 (large capacity 165,000 m^3 diesel vessel) and 27,000 m^3 (125,000 to 165,000 m^3 steam-driven vessels) of water to support hoteling needs during the 21-hour period. Diesel powered vessels use a different propulsion system, which requires less water. A breakdown of water intake estimates for the range and type of LNG vessels that are anticipated to service the port are summarized in table 4.2-1. Ballast, engine cooling, and hoteling water would be drawn through intake openings (sea chests) on the side of the vessel. These openings would be covered with a strainer plate with slots designed to prevent intake of large objects. Aquatic organisms including zooplankton, icthyoplankton, and mysid shrimp in the immediate vicinity of the LNG vessel could therefore be subject to impingement and/or entrainment during water intake. Ballast, engine cooling, and hoteling intakes on the LNG vessels are located near the bottom of the vessel, and therefore, impingement and/or entrainment would be limited to organisms in the deeper water column (30 to 35 feet below the surface).

Table 4.2-1

Vessel Seawater Usage Impacts to Fish Eggs, Fish Larvae, and Zooplankton per Visit Based on Worst Case Densities

Ship class a/	Cooling flow rate b/ (m^3/hr)	Time in port c/ (hrs)	Ballast volume d/ (m^3)	Total seawater usage/visit e/ (m^3)	% of Total area flow f/	% of Total regional flow g/	Mean Fish eggs h/ (#/m^3)	Total fish egg loss/visit i/	Mean Ichthy. j/ (#/m^3)	Total ichthyo loss/visit k/	Mean Zooplanton l/ (#/m^3)	Total zooplankton loss/visit m/
Full load ballast												
125K MT	6,341	21	53,683	186,835	0.058%	0.013%	0.541	101,078	0.177	33,070	3733	697,455,704
138K MT	7,000	21	53,107	200,107	0.062%	0.014%	0.541	108,258	0.177	35,419	3733	746,999,431
145K MT	7,355	21	56,964	211,421	0.066%	0.015%	0.541	114,379	0.177	37,421	3733	789,232,808
165K MTS	8,000	21	64,759	232,759	0.072%	0.016%	0.541	125,923	0.177	41,198	3733	868,889,347
165K MTD	500	21	64,759	75,259	0.023%	0.005%	0.541	40,715	0.177	13,321	3733	280,941,847
Light load ballast (80.8% of full load ballast)												
125K MT	6,341	21	43,372	176,524	0.055%	0.012%	0.541	37,776	0.177	31,245	3733	658,964,741
138K MT	7,000	21	42,910	189,910	0.059%	0.013%	0.541	40,641	0.177	33,614	3733	708,935,732
145K MT	7,355	21	46,027	200,483	0.062%	0.014%	0.541	42,903	0.177	35,486	3733	748,404,658
165K MTS	8,000	21	52,325	220,325	0.068%	0.015%	0.541	47,150	0.177	38,998	3733	822,473,225
165K MTD	500	21	52,325	62,825	0.020%	0.004%	0.541	13,445	0.177	11,120	3733	234,526,740

a/ Ship size class in thousands of metric tons
b/ Flow rate source: John Egan, Marine Master, personal communication 2006
c/ Estimated time in port/at dock: John Egan, Marine Master, personal communication 2006
d/ Ballast volume source: John Egan, Marine Master, personal communication 2006
e/ Total seawater usage per visit = cooling flow rate x time in port + ballast volume
f/ Mean tidal flow (322×10^6 m^3) across line from St. Andrews, New Brunswick and Lewis Cove, Robbinston, Maine - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27
g/ Mean ebb and flood tidal flow((1452×10^6 m^3) in and out of Passamaquoddy Bay through Western Passage - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27
h/ Based on maximum October 2006- November 2008 fish egg sampling in Mill Cove (July 2009)
i/ Mill Cove annual maximum total fish egg count multiplied by total visit seawater usage
j/ Based on maximum October 2006- November 2008 ichthyoplankton sampling in Mill Cove (July 2009)
k/ Mill Cove annual maximum ichthyoplankton count multiplied by Total visit seawater usage
l/ Based on maximum October 2006- November 2008 zooplankton sampling in Mill Cove (July 2009)
m/ Mill Cove annual maximum total zooplankton count multiplied by total visit seawater usage
MT=Motor Tanker ; MTD=Motor Tanker Diesel; MTS=Motor Tanker Steam

Given the water requirements of the LNG vessels while berthed at the pier, it is likely that vessels servicing the Downeast LNG import terminal would have some impact on fish eggs and larvae. In general, the pier would be within the mixing zone of the estuary with salinities between 0.5 and 25.0 ppt (NOAA, 1985) and at depths less than 60 ft (18 m). Depth and salinity indicate that the LNG vessels are unlikely to impact eggs and larvae of ocean pout. In addition, pollock larvae are found in deeper, higher salinity waters and are likewise not likely to be entrained by LNG vessels at the port. American plaice eggs, sea scallop larvae, Atlantic herring larvae, and windowpane flounder eggs and larvae, other aquatic organisms including zooplankton, other icthyoplankton, and mysid shrimp in the immediate vicinity of the LNG vessel could be subject to impingement and/or entrainment during water intake. Winter flounder eggs and larvae are demersal and therefore are unlikely to be subject to impingement and/or entrainment during water intake.

Ballast, engine cooling, and hoteling intakes on the LNG vessels are near the bottom of the vessel, and therefore, impingement and/or entrainment would be limited to organisms in the deeper water column (30 to 35 feet below the surface). The impacts on ichthyoplankton, zooplankton, and mysid shrimp related to the water used by vessels servicing the Downeast LNG terminal would vary based on a number of conditions including time of year, vessel type, vessel size, and duration at port. Loss estimations of ichthyoplankton and zooplankton from intakes associated with engine cooling and ballasting for each vessel class, species densities (worst case), and 100 percent mortality are included in appendix O of the EIS. Hoteling water intakes were not included within the context of this impact assessment; however, intake for this purpose would be relatively minor compared to those associated with engine cooling and ballasting. As indicated in table 4.2-1, the total ichthyoplankton loss per visit for a full load ballast, based on plankton sampling to date, ranges from a low of about 13,300 for a 165,000 m^3 diesel vessel to a high of 41,000 for a 165,000 m^3 steam-driven vessel.

Downeast LNG would not build, own, or operate the LNG vessels bringing LNG to the terminal and would not have contractual control over the LNG vessel operations related to water intake while at the terminal. As a practical matter ballast water is a requirement to maintain vessel stability while at the berth. Because proper ballasting is a safety issue, Downeast LNG would not be in a position to second guess the LNG vessels' officers in using their judgment as to the timing, amount, or velocity of ballast water to take, which can vary due to certain factors (e.g., existing weather and sea conditions). The Emergency Fire Suppression system along the pier would also require the use of seawater during periodic system testing with the potential to adversely impact ichthyoplankton and zooplankton near the Downeast LNG Project area (see table 4.2-2). Species composition would be the same as that described for LNG vessel water intake. Downeast's fire suppression system would consist of seven pumps that would draw water from a minimum of 30 feet, at a total capacity of 3,000 gpm and a total test flow rate of 4,769 m^3/hr. Downeast would test the pumps weekly and require a total of 681.37 m^3 of seawater for a test period of at least one hour per system test. Annual ichthyoplankton losses resulting from the emergency fire suppression testing are estimated to be 43,895 and egg losses resulting from the emergency fire suppression testing are estimated to be 134,164. The total annual zooplankton loss from emergency fire suppression system testing is estimated to be 926 million.

Table 4.2-2 Fire Suppression Seawater Usage Impacts to Fish Eggs, Fish Larvae, and Zooplankton per Visit Based on Worst Case Densities													
Number Fire pumps	Pump flow rate (gpm)	Total test flow rate a/ (m^3/hr)	Test period (hrs)	Total test volume b/ (m^3)	Max. Fish eggs c/ (#/m^3)	Total fish egg loss/test d/	Total fish egg loss/year e/	Max. Ichthy.f/ (#/m^3)	Total ichthy. loss/ test g/	Total ichthy. loss/year h/	Max. Zooplankton i/ (#/m^3)	Total zooplankton loss j/	Total Annual zooplankton loss k/
7	3,000	4,769	1	4,769	0.541	2,580	134,164	0.177	844	43,895	3733	17,803,050	925,758,616

a/ Total test flow rate (m^3/hr) = (Pump flow rate (gpm) * 7) * 60min)*3.785 l/gal)/1000 l/m^3
b/ Total test volume = Total test flow rate * Test period
c/ Based on maximum October 2006- November 2008 fish egg sampling in Mill Cove (July 2009)
d/ Mill Cove annual worst case total fish egg count multiplied by total test volume
e/ Total fish egg loss/test * 52 tests/year
f/ Based on maximum October 2006- November 2008 ichthyoplankton sampling in Mill Cove (July 2009)
g/ Mill Cove annual worst case total ichthyoplankton count multiplied by total test volume
h/ Total ichthyoplankton loss/test * 52 tests/year
i/ Based on maximum October 2006- November 2008 zooplankton sampling in Mill Cove (July 2009)
j/ Mill Cove annual worst case zooplankton count multiplied by Total test volume
k/ Total zooplankton loss/test * 52 tests/year

Impingement and/or entrainment of aquatic organisms (including fish eggs and larvae) would also likely occur during transit to and from the terminal as a result of water withdrawals to support vessel operational requirements. Such species would include, but are not limited to, American plaice and pollock larvae, and ocean pout eggs and larvae. However, because vessels would be drawing water as they transit across deep open waters, the potential impact would be transient and therefore not a significant impact to any particular localized aggregation of aquatic organisms.

Loss of fish eggs and fish larvae has implications to the individual species populations, but the magnitude and significance of those implications is currently unclear given the very high mortality of fish eggs and larvae, with very few larvae surviving through the first year. The high mortality of larvae is due to natural attrition as well as predation, therefore there may be some implication to predator species, but again the significance of the potential LNG vessel-associated loss may be small relative to natural, non-predator mortality and the availability of other area-wide or region-wide prey. Similarly, zooplankton is at the base of the oceans food web providing prey to higher trophic levels, including fish and filter-feeding whales. Werth (2004), working on hydrodynamic flow models of bowhead filter feeding apparatus, calculated a flow rate of 5.65 m^3/sec for a 15m whale moving at a foraging speed of 4 km/hr. This feeding rate, if sustained over an hour, would result in a feeding flow volume of 20,340 m^3/hr, more than 2.76 times the flow rate through a 145,000 metric ton LNG vessel in port with a flow rate of 7,355 m^3/hr. Goldbogen et al. (2006) studying foraging dives and lunge feeding in fin whales estimated filtering rates at 1m^3/sec, equivalent to 3,600 m^3/hr if sustained for an hour. Additionally, as with fish larvae, the significance of the potential LNG vessel-associated loss may be small relative to natural, non-predator mortality and the availability of other area-wide or region-wide prey. Despite these estimated losses, we believe the significant tidal fluctuations and water exchange that occurs in the Downeast LNG Project area; the high densities of ichthyoplankton; and the comparatively small amount of water withdrawn suggest that the overall impacts on fish eggs and larvae of EFH designated species in the Downeast LNG Project area would have an inconsequential effect on overall community populations and associated fish stocks.

The proposed LNG terminal pier would be in Mill Cove slightly south of the confluence of Passamaquoddy Bay and St. Croix River. The outlet of Passamaquoddy Bay exchanges water with the Bay of Fundy (see figure 2-4). This general area is known for its extreme tidal range and swift currents. Downeast states that, although the LNG terminal berth and offloading facility would have the potential to handle future vessels of 220,000 m^3, the largest vessel that would be accommodated at the import facility would be a 165,000 m^3 LNG vessel. Such a vessel would require about 64,759 m^3 of water, which would be obtained in Passamaquoddy Bay and transported out of the waterway. This quantity is estimated to be about 0.0003 percent of the quantity of water that flows in and out of Passamaquoddy Bay during one tidal cycle. However, NOAA Fisheries staff has expressed concern for plankton losses due to water withdrawals from LNG vessel visits to the Downeast LNG terminal. NOAA Fisheries has recommended monitoring activities to confirm our conclusions. NOAA Fisheries has suggested that such monitoring activities would provide baseline information to assist in adaptive mitigation, should the need arise, for managing potential impacts on these species. NOAA Fisheries has encouraged continued consultation to develop a monitoring plan and/or compensatory mitigation program, if necessary, to offset 'life cycle' impacts that may result from the Downeast LNG Project. While we understand NOAA Fisheries' request for ichthyoplankton and zooplankton field survey data during water withdrawals by the LNG carrier, we believe that Downeast's use of best available scientific data for plankton impacts are adequate to determine impacts. Further, we note that Downeast would have no control over the LNG vessels calling on the Project, and would not be able to conduct adaptive management to minimize impacts on the plankton during operation of the vessels.

During operation, engine cooling water discharged from LNG Vessels servicing the Downeast LNG import terminal is expected to create temperature changes at and around the vessel's outflow. We expect thermal impacts associated with vessel engine cooling discharge waters would also be minor and insignificant. Downeast's CORMIX modeling indicates that vessel engine cooling discharges would result in a maximum 26-square meter plume of water that would dissipate to a change of temperature of approximately 1.8°F (1°C) or less warmer than ambient conditions 15 to 30 meters from the discharge source (see EIS appendix O). The water temperature in the vicinity of the terminal site rarely rises above 57°F (14°C). Tolerable temperature ranges per species with EFH designation in and adjacent to Passamaquoddy Bay are presented in table 4.2-3. Given the limited extent of temperature change and the rapid mixing due to currents and tidal flow, numbers of individual eggs and larvae exposed to temperatures exceeding their maximum tolerances is expected to be minor and insignificant. In addition, because the facility would accommodate only one vessel at a time, and tidal velocities would rapidly disperse any created thermal plumes, any engine cooling impacts would be significantly less in extent and scope than those associated with existing harbors with multiple vessel operations.

Facility operation would also increase the risk of unintentional releases of fuel and other contaminants. Such an event could have adverse effects on EFH and fish species. Mitigation and remedial measures have been addressed in the developmental phases of the project, and preventative and response plans would be required (e.g., SPCC Plan, Shipboard Oil Pollution Emergency Plan, Vessel General Permit) to minimize/eliminate the potential impacts due to such events (i.e., fuel spill, surface water fire, or disabled vessels, for example). If such an event does occur, incidental adverse impacts on fish and designated EFH may be likely; however, it is anticipated that these effects would be temporary in duration and scope.

There is a very low probability that an area of the pipelines associated with the LNG transfer system would fail, or that an LNG vessel spill from collisions, allisions, or terrorist attacks would release LNG into the marine environment.

Table 4.2-3

Temperature Ranges for Fish Species with EFH Designation in the Passamaquoddy Bay Area
Temperatures are Expressed in Degrees Fahrenheit (°F)

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
American plaice *(Hippoglossoides platessoides)*	33.8-53.6	39.2-57.2	39.2-60.8	37.4-59	37.4-42.8
Atlantic cod *(Gadus morhua)*	< 53.6	39.2-51.8	< 68	33.8-62.6	< 50
Atlantic halibut *(Hippoglossus hippoglossus)*	39.2-44.6		35.6	< 56.48	< 44.6
Atlantic herring *(Clupea harengus*	< 59	< 50	< 50	< 50	< 59
Atlantic mackerel *(Scomber scombrus)*	41-73.4	42.8-71.6	39.2-71.6	39.2-60.8	
Atlantic salmon *(Salmo salar)*	< 50	< 50	< 77	73.04	< 68
Atlantic sea scallop *(Placopecten magellanicus)*	< 62.6	< 64.4	< 59	< 69.8	< 60.8
Ocean pout *(Macrozoarces americanus)*	< 50	< 50	< 57.2	< 59	42.8-48.2
Pollock *(Pollachius virens)*	< 62.6	< 62.6	< 64.4	32-57.2	< 46.4
Red hake *(Urophycis chuss)*	< 50	< 66.2	< 60.8	< 53.6	< 50
White hake *(Urophycis tenuis)*	44.6-68	50-64.4	46.4-66.2	41-57.2	< 57.2
Whiting *(Merluccius bilinearis)* also called Silver hake	< 68	< 68	< 69.8	< 71.6	< 55.4
Windowpane flounder *(Scopthalmus aquosus)*	42.8-68	< 68	39.2-60.8	< 80.24	< 69.8
Winter flounder *(Pleuronectes americanus)*	< 50	< 59	< 77	< 59	37.94-42.08

Sources: National Oceanic and Atmospheric Administration (NOAA) Fisheries Service web page - EFH Designations for New England Skate Complex (http://www.nero.noaa.gov/hcd/skateefhmaps.htm). All other species: NOAA Fisheries EFH designations web page for Passamaquoddy Bay, Maine 10 x 10 minute grid cell (http://www.nero.noaa.gov/hcd/STATES4/nmaine.htm). Accessed 22 March, 2007.

Note: This table provides available information on tolerable temperature ranges in regard to EFH designated species; this does not suggest that all noted species and/or life-stages are known to be present within the project area of Passamaquoddy Bay.

5.0 MITIGATION

Downeast would implement mitigation measures during all stages of the Downeast LNG Project, as applicable, maximizing protection of the EFH and designated species by either avoiding adverse impacts, or minimizing the potential for adverse impacts. Downeast has identified a number of mitigation measures to avoid, minimize, or compensate for impacts on EFH due to construction and operation of its Downeast LNG Project. The FERC staff also intends to include recommendations in the EIS that will provide additional mitigation measures for impacts on aquatic resources, including EFH. Some of the primary EFH mitigation measures include:

- The installation of the pier using a conventional "over-the-top" method of construction whereby the pier trestle is constructed from the shore seaward. This method of installation would limit the use of barge-mounted equipment reducing the amount of impacts to the Cove seabed from anchoring, as well as reduce the area of habitat disturbance and loss from propeller wash.
- All vessels over 65 feet (19.8 meters) involved with construction, or future operations of the Downeast LNG terminal would comply with ship strike rules (50 CFR Part 224.105) in US waters. In addition, from July through October, vessels would slow to 10 knots upon entering Grand Manan Channel, on a line drawn between Cutler, Maine and the southwestern tip of Grand Manan Island, or approximately 44.6^{o} north latitude. Vessels departing the Downeast LNG terminal from July through October, via the Grand Manan Channel, would not exceed 10 knots until south the previously specified latitude.
- All vessels over 65 feet (19.8 meters) navigating the BOF TSS that are involved with construction, or future operations of the Downeast LNG terminal would slow to 10 knots upon northwesterly course adjustment near 44.5^{o} north latitude from July through October. Vessels bound for the Downeast LNG terminal would remain at 10 knots or slower until their arrival at the terminal, or until control is relinquished to a tug. Vessels departing the Downeast LNG terminal from July through October, via the BOF TSS, would not exceed 10 knots until after making the southwesterly course adjustment near 44.5^{o} north latitude.
- Downeast stated that based on current design and engineering the project could be constructed using only vibratory hammering for pile driving, and committed to the singular use of vibratory hammering for the installation of piles
- Underwater noise levels would be mitigated for to ensure that the extent of the 150 dB re 1µPa Root Mean Squared isopleth (i.e., the level of underwater noise believed to cause behavioral modification in sturgeon and other diadromous species) does not prevent passage of species within the affected body of water, particularly between March 15 and July 30. While individuals may be displaced from, or avoid, the ensonified area, there must always be a zone of passage where noise levels remain below 150 dB re 1µPa Root Mean Squared.
- Downeast would determine the effectiveness of the mitigated pile driving by modeling sound levels throughout the ensonified area and provide an updated isopleth map to NOAA Fisheries prior to the issuance of a concurrence letter.

- During construction, Downeast LNG would record PEAK sound pressure level and calculate Cumulative Sound Exposure Level (CSEL) and Root Mean Squared from the sound pressure level waveform and report results to NOAA Fisheries staff on a daily basis.
- During rock socket drilling and pile driving, Downeast LNG would monitor sound pressure level with hydrophones and a digital recorder capable of operating at a minimum of 600,000 samples per second for a minimum of one second, with an adjustable trigger level, and a range of at least 30 psi. Based on protocol for measuring in-water acoustic fields and natural noise attenuation of 3-6 dB per doubling of distance, a minimum of three locations will be monitored, located approximately 10, 20, and 40 meters from the sound source.
- A post-project report, confirming completion of construction and the successful application of all terms and conditions of this permit, must be submitted within four (4) weeks of project completion. Submit post-project reports to NOAA Fisheries and to FERC.
- Due to the water depth and vessel draft, the use of ship's bow thrusters are prohibited, subject to conflicting Coast Guard or Pilot requirements necessarily imposed for navigational safety and/or security, during low tide when approaching/departing the pier or while docked.
- The use of construction timing windows to avoid sensitive periods such as spawning, migration, and peak fishery activity is a viable mitigation method. Timing may also include avoiding equipment relocation activity during specific periods of the diurnal tide to avoid excessive disturbance to the bottom and reduce sediment resuspension by construction vessels. We recommended in the EIS that FERC staff will review all supplemental information when filed, and will consult with resource agencies regarding recommended seasonal or construction timing restrictions to minimize impacts on marine species and habitats during all proposed in-water work and pile driving activities at the LNG terminal. On July 10, 2009 Downeast filed with the Secretary its response to the condition including a June 3, 2009 memorandum to NOAA Fisheries, Maine DMR, Maine DEP, and Maine DIFW. Downeast concluded, "While Downeast LNG will continue to consult with the appropriate agencies to determine any recommended construction timing restrictions to minimize habitat impacts (and will file such information with the Commission upon receipt), the state permitting process in Maine will include a detailed review of these issues, including any required mitigation measures. Until such time as the state permitting process is concluded and all relevant state resource agencies have provided their input through that process, Downeast LNG likely will not have all state agency recommendations concerning seasonal or construction timing restrictions."
- The use of intake screens to minimize entrainment and the control of intake rates during hydrostatic testing and fire system testing to minimize entrainment and impingement of aquatic organisms.

We believe that we have addressed in this EFH Assessment all of NOAA Fisheries concerns. Additionally, the FERC staff welcomes any additional comments that NOAA Fisheries may have.

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Appendix H

M&NE Soil Erosion and Sediment Control Guidelines

Maritimes & Northeast Pipeline

Phase IV – Maine Facilities

Soil Erosion and Sediment Control Guidelines

May 2006

Prepared by:

TRC
Customer-Focused Solutions

Prepared for:

Maritimes & Northeast Pipeline

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1.0 INTRODUCTION

Maritimes & Northeast Pipeline, L.L.C. ("Maritimes & Northeast") is proposing to use the following Soil Erosion and Sediment Control Guidelines ("SESCG") during construction of the Phase IV Project to minimize erosion of disturbed soils and transportation of sediments off the right-of-way ("ROW") and into sensitive resource areas (streams, wetlands). This SESCG is very similar to the SESCG that was approved by the Federal Energy Regulatory Commission ("FERC") and State of Maine regulatory agencies during the permitting and construction of the Phase II facilities. However, this version of the SESCG has been updated to reflect the January 2003 amendments to the FERC *Upland Erosion Control, Revegetation, and Maintenance Plan* and the *Wetland and Waterbody Construction and Mitigation Procedures*, which were implemented after the completion of the Phase II facilities. In addition, this SESCG incorporates variances that were approved and specific Maine Department of Environmental Protection ("MEDEP") measures that were requested during construction of the Phase II Project. In addition, some re-organization and revisions have been made to add clarification where needed. This version of the SESCG is in DRAFT form and additional revisions to the text and figures may be made prior to the next submission of this document.

This document is intended to be a stand-alone document, containing all Project requirements related to erosion and sediment controls and stream and wetland protection measures. The goal of this document is to supply pipeline contractors, Maritimes' Environmental Inspectors and craft inspectors, and agency monitors with a single cohesive set of erosion control specifications for this project. The procedures developed in these guidelines are based on the applicable requirements of the following documents and standards as well as on significant experience and practical knowledge of pipeline construction and effective environmental protection measures. Lessons and insights gained during pipeline construction of the Maritimes & Northeast Phase II Project 1999 and comments from agency representatives were also incorporated into this document. Specific regulatory agency sources for these standards include, where applicable, the following documents:

- MEDEP *Pipeline Erosion Control Standards* (November 6, 1996)
- State of Maine Erosion and Sediment Control Best Management Practices (03/2003)
- FERC *Upland Erosion Control, Revegetation, and Maintenance Plan* (01/17/2003 version) (Appendix A)
- FERC *Wetland and Waterbody Construction and Mitigation Procedures* (01/17/2003 version) (Appendix B)

This document is designed to provide specifications for the installation and implementation of soil erosion and sediment control measures while permitting adequate flexibility to allow application of the most appropriate measures based on site-specific conditions. The intent of these guidelines is to provide general information on the pipeline construction process and to describe specific measures that will be employed during and following construction to minimize impacts to the environment along the pipeline ROW.

The SESCG represents the latest measures developed to prevent erosion and sedimentation resulting from pipeline construction. Control methods included herein include temporary controls to be employed during construction and permanent controls to insure that post-construction erosion is avoided. In addition, plans for revegetation and permanent vegetative stabilization are drawn from the specific standards and specifications from the Maine BMP's.

The primary goals of any erosion and sedimentation plan are to preserve the integrity of environmentally sensitive areas and to maintain existing water quality. Implementation of the following objectives is required to achieve those goals:

- Minimize the extent and duration of disturbance,
- Protect exposed soil by diverting runoff to stabilized areas,
- Install temporary and permanent erosion control measures, and
- Establish an effective inspection and maintenance program.

In addition, the SESCG has been developed to comply with the applicable federal and state of Maine regulatory standards that must be met by the proposed construction. The organization of these recommended guidelines is as follows:

- <u>Section 2.0</u> – Describes the construction process and techniques used in the installation of natural gas pipelines.

- <u>Section 3.0</u> – Outlines the procedures required for waterbody crossings that minimizes the disturbance of stream and wetland ecosystems to the maximum extent practicable.

- <u>Section 4.0</u> – Contains the procedures that must be used when crossing wetlands as defined by the ACOE 1987 Wetland Delineation Manual (Technical Report Y-87-1) and the most recent performance standards and supplemental definitions required by the New England Division.

- <u>Section 5.0</u> – Presents a discussion of structural and vegetative erosion control measures used in pipeline construction to protect and stabilize environmentally sensitive areas.

At this time, many of the Appendices to the document are in draft form, and not included with this version of the SESCG. Portions of certain Appendices, such as the dam and pump procedures, will be incorporated into the body of the SESCG.

Appendix C contains figures that illustrate Maritimes' typical construction right-of-way configuration. Appendix D contains a listing of Federal and Maine State Regulatory Agency personnel and offices. Appendix E contains the Waterbody Crossing Table. Appendix F will contain the Hydrostatic Test Plan. The hydrostatic test plan will be developed through the state permitting process and provided as part of the Implementation Plan. Appendix G contains the Phase II Wetland Restoration Procedures for Temporary Wetland Impacts. Appendix H contains the Maritimes & Northeast Pipeline Phase IV – Draft Blasting Plan. The Blasting Plan will be revised as part of the State of Maine permitting process and will be provided when finalized as part of the Implementation Plan. Appendix I will contain the Maritimes & Northeast Pipeline Phase IV- Spill Prevention Control and Countermeasure Plan. This Plan will be developed as part of the Implementation Plan and incorporate spill prevention control and countermeasure plan materials from Maritimes as well as from the contractor(s) eventually chosen to construct the facilities. Appendix J contains Maritimes & Northeast Pipeline Phase IV - Wood Chip Application and Management Plan.

1.1 Supervision and Inspection

To effectively mitigate project-related impacts, the erosion control plan must be properly implemented. Field decisions may often be required regarding timing of stream crossings, placement of erosion controls, trench dewatering, revegetation and other construction related items. To ensure proper implementation of the erosion control plan, an Environmental Inspector will be assigned to each construction spread of the project and be on the job site at all times during active construction. The Environmental Inspector will be employed by Maritimes & Northeast to supervise the environmental aspects of pipeline construction activities and will report directly to the Chief Inspector. Environmental Inspectors shall have the authority to stop activities that violate the environmental conditions of the FERC certificate or other authorizations and order corrective action. The Environmental Inspector should have pipeline experience, be experienced in erosion control techniques and have an understanding of the wetland and waterbody resources required to be protected.

Responsibilities of the Environmental Inspector include working with the contractors and company to ensure project compliance with the SESCG, *Erosion Control, Revegetation, and Maintenance Plan and the Wetland and Waterbody Construction and Mitigation Procedures* of the FERC certificate, and other applicable environmental permits, conditions, approvals, and any environmental requirements stipulated in landowner easement agreements. Specific duties include: verifying the contractor has marked the location of drainage and irrigation systems, verifying all authorized construction work areas are marked before clearing, supervising the proper installation and maintenance of erosion control devices, ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, working with the contractors and the Company to ensure compliance with environmental permit conditions, supervision of all dewatering activities, documentation of temporary and permanent revegetation programs, ensuring restoration of contours and topsoil, coordination with environmental regulatory agencies, ensuring the Contractors' appropriate implementation of the spill prevention control plan, inspecting Contractor activities to ensure implementation of the NPDES construction stormwater general permit plan, testing subsoil and topsoil for compaction, verifying that any imported soils for residential and agricultural use are free of noxious weeds and soil pests, determining corrective action and implementation of additional measures deemed necessary based on field or weather conditions and identifying areas that should be given special attention to ensure stabilization and restoration following construction.

The Environmental Inspector shall meet with the Chief Inspector and the Contractor to determine the sequence of construction and the placement of erosion control measures to be employed The Environmental Inspector will conduct detailed inspections of erosion controls on a daily basis in areas of active construction and on a weekly basis in areas with no construction, and following major storm events generating greater than 0.5 inches of rainfall. The Environmental Inspector will keep records of compliance with the environmental conditions of the FERC certificate, and the mitigation measures proposed by Maritimes & Northeast in the application submitted to the FERC, and other Federal and state environmental permits during active construction and restoration.

The Environmental Inspector will also participate in periodic coordination meetings with the Chief Inspector and contractor personnel during construction and will advise the Chief Inspector when conditions make it advisable to restrict construction activities to avoid and minimize excessive soil rutting.

1.2 Environmental Training for Construction

As required by FERC, environmental training will be given to both Company and contractor personnel whose activities will impact the environment during pipeline construction. The level of training will be commensurate with the type of duties of the personnel. All construction personnel from the Chief Inspector, Environmental Inspector, craft inspectors, contractor job superintendent to loggers, welders, equipment operators, and laborers will be given some form of environmental training. The training will be given prior to the start of construction and throughout the construction process, as needed. The training program will cover FERC's Plan and Procedures, the SESCG, job specific permit conditions, company policies, cultural resource procedures, threatened and endangered species restrictions, Spill Prevention Control and Countermeasure Plan, NPDES Stormwater Plan, and any other pertinent information related to the job. In addition to the Environmental Inspector, all other construction personnel are expected to play an important role in maintaining strict compliance with all permit conditions to protect the environment during construction.

2.0 CONSTRUCTION TECHNIQUES FOR NATURAL GAS PIPELINES

Maritimes & Northeast will use appropriate construction techniques and mitigation measures designed to minimize potential impacts to the environment. Preventative measures will include vegetative stabilization, construction of permanent and temporary controls, and implementation of inspection and maintenance programs. While the specifics of pipeline construction are dependent upon existing site conditions at the time of construction, the following section describes typical pipeline construction techniques with environmental control measures.

2.1 Typical ROW Requirements

There will be one typical configurations of the construction ROW for the Phase IV Project. This configuration is described below. Appendix C contains figures that illustrate Maritimes' typical construction right-of-way configuration.

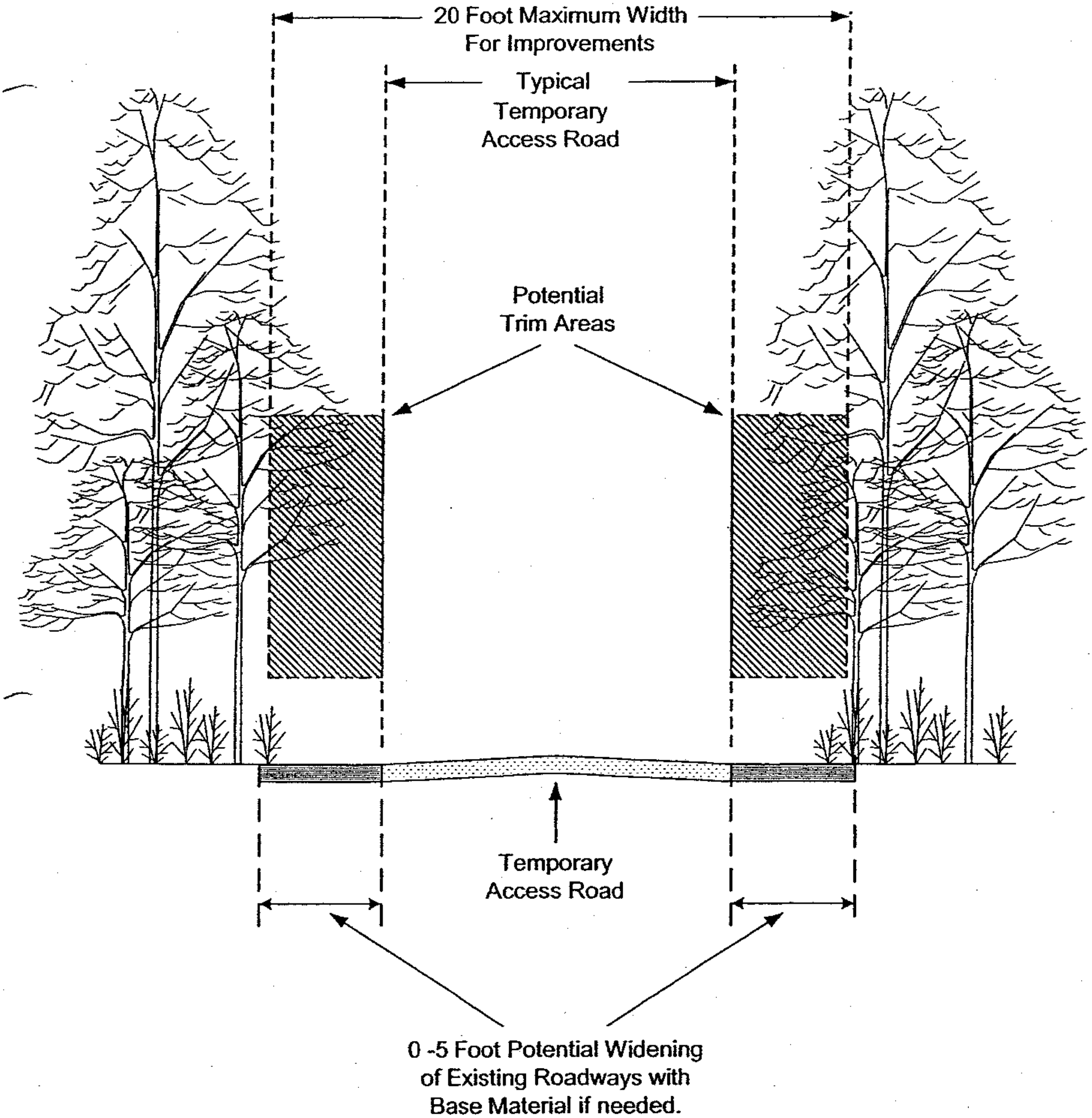
Portion Adjacent to Existing Pipeline ROW Only

In areas where the Loop is parallel to the existing Phase II Mainline the construction ROW will consist of (i) the entire 50-foot existing, cleared permanent ROW, (ii) 25 feet of new permanent ROW adjacent to the existing permanent ROW, and (iii) 30 feet of additional temporary ROW. The total construction ROW width will be 105 feet wide. The permanent ROW width will increase from 50 feet to 75 feet. The Loop is offset from the existing Phase II by 25 feet, centerline to centerline, throughout this area. Figure "DWG.NO. config-1" is the typical configuration of the ROW segments that are parallel to the existing pipeline ROW.

Generally, the construction working side of the ROW will be 55 feet wide and the side used for spoil storage will be 50 feet wide. However, the spoil side will be reduced to 40 feet wide in wetlands and within 25 feet of top of banks at streams (total construction ROW width of 95 feet in these resource areas).

2.2 Access Roads for Construction

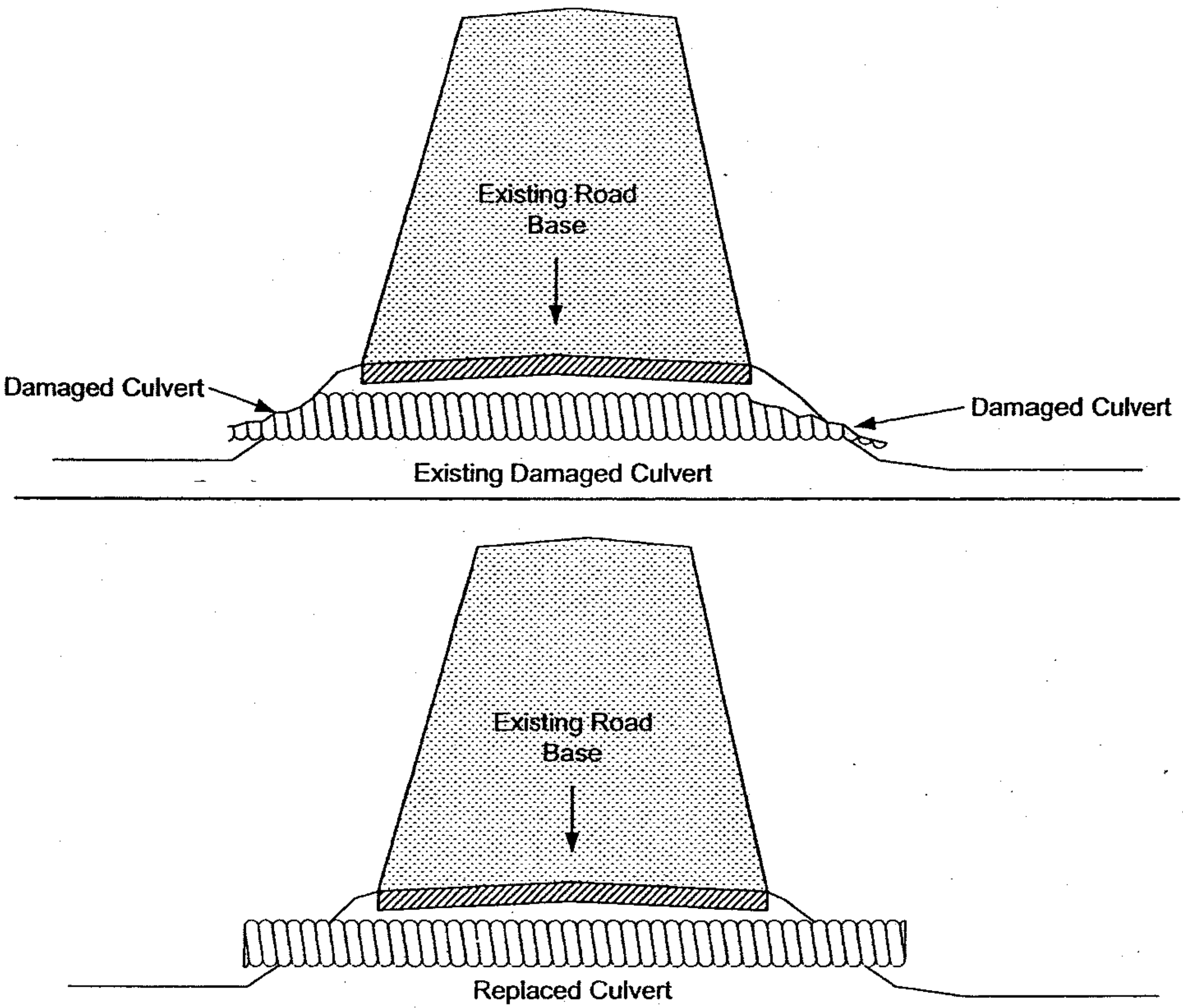
All access to the construction ROW will primarily be on existing roads to the extent possible. Additional access roads to the ROW are required at various points along the project where there are no existing public road crossings. Additionally, further justification for access roads is FERC's Procedures that require limited access through wetlands to the extent possible. Examples of types of access used are abandoned town roads, railroad ROWs, powerline access roads, logging roads, and farm roads. An approximately 15 to 25 foot wide road is needed to accommodate large pipeline equipment such as tractor trailer pipe trucks and equipment transporters, excavators, sidebooms, and all other pipeline construction support vehicles. The width of the road is dependent on slope and road alignment. Because of type of equipment traveling on the access road, improvements may be required which consist of grading, laying of gravel for stability, replacing culverts, and clearing over hanging vegetation (refer to Figures 1 and 2). Where approved access roads pass through wetlands several measures may be taken to stabilize the existing road surface to create safe travel. These measures include laying heavy gauge geotech fabric down and placing gravel on top to facilitate restoration (refer to Figures 3 and 4) and/or using wooden construction mats with the integration of culverts where applicable.



Note: Not to Scale

Maritimes & Northeast Pipeline	Typical Temporary Access Road Cross Section	Figure 1 Date: March, 1999

EV. 04678 4678-33A

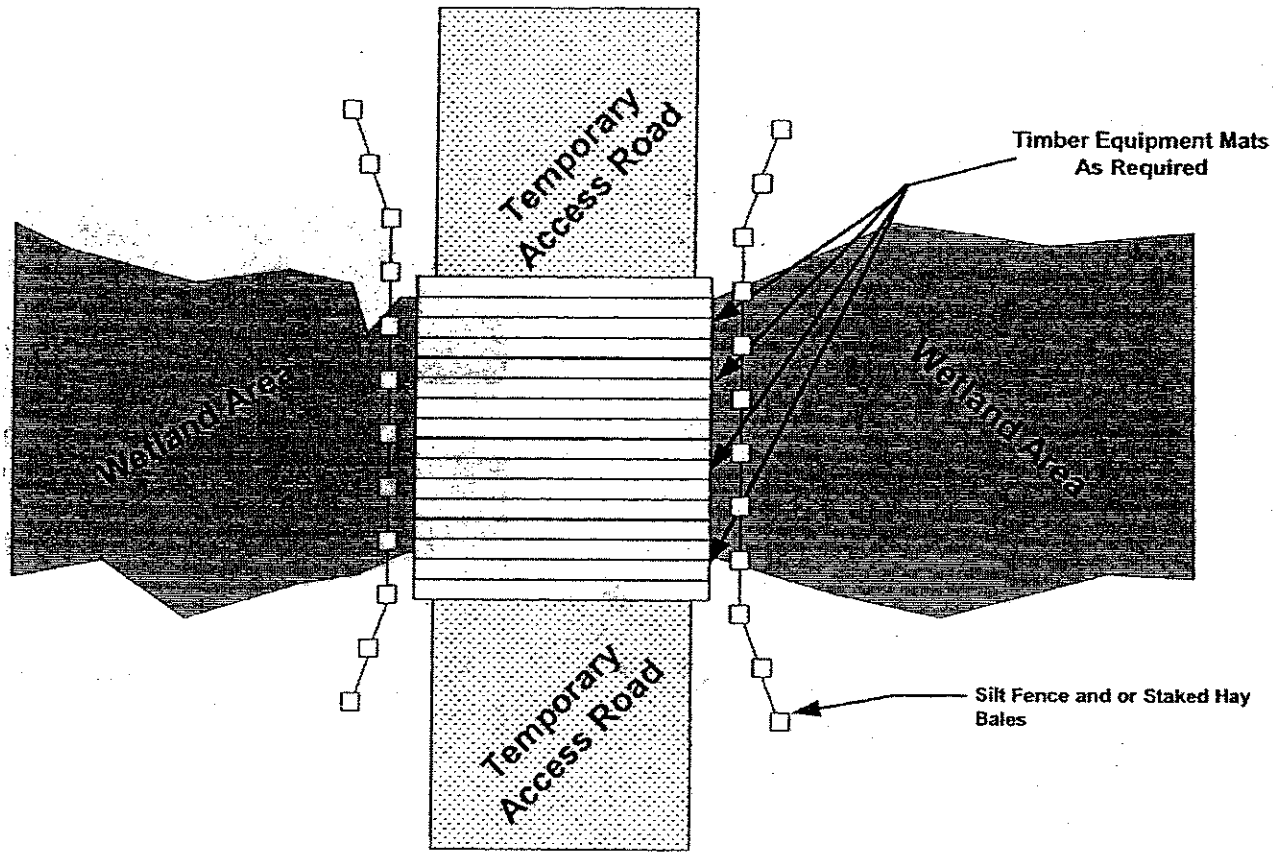


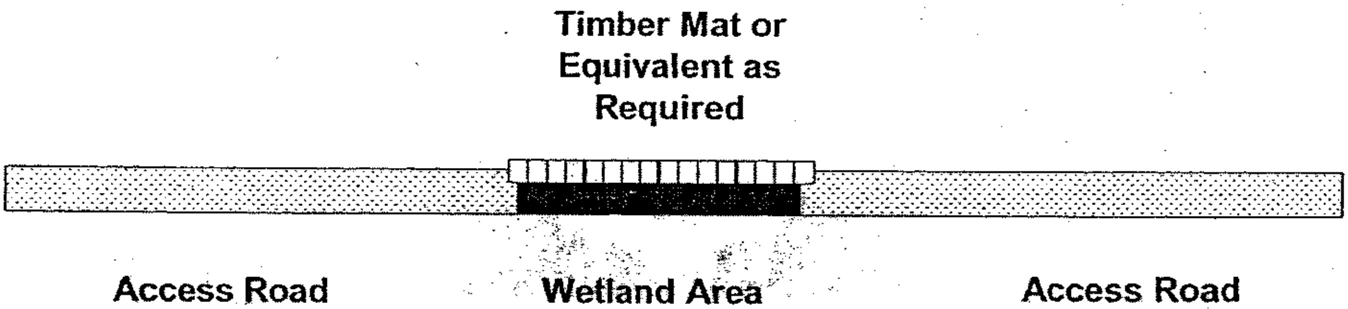
Culverts will be replaced on an as needed basis
with the same size invert, and length culvert.
If widening of road is required a longer culvert will be installed.

Note: Not to Scale

Maritimes & Northeast Pipeline	**Typical Temporary Access Road Culvert Replacement**	**Figure 2** **Date: March, 1999**

ev. 04678 4678-29





Note: Not to Scale

Maritimes & Northeast Pipeline	Typical Temporary Access Road Equipment Mat Cross-Section	Figure 3 Date: March, 1999

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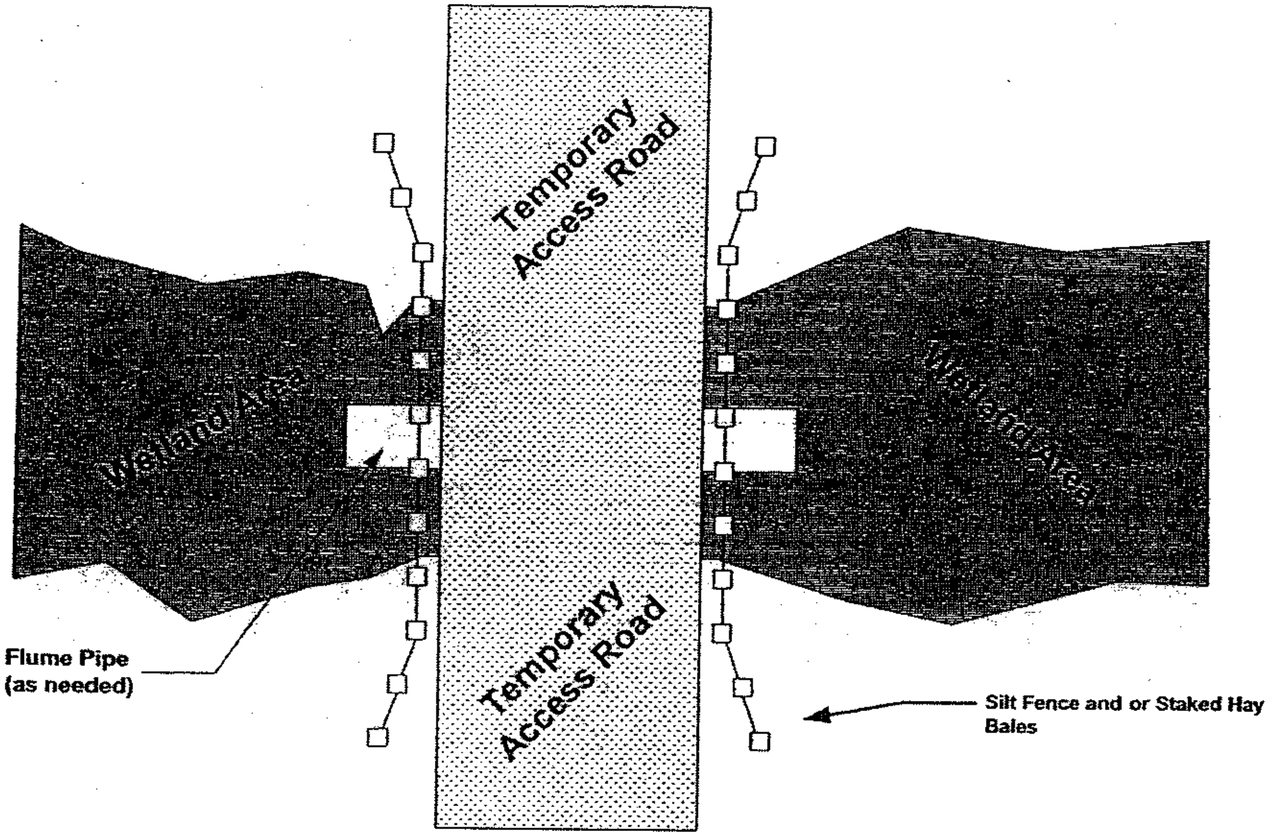
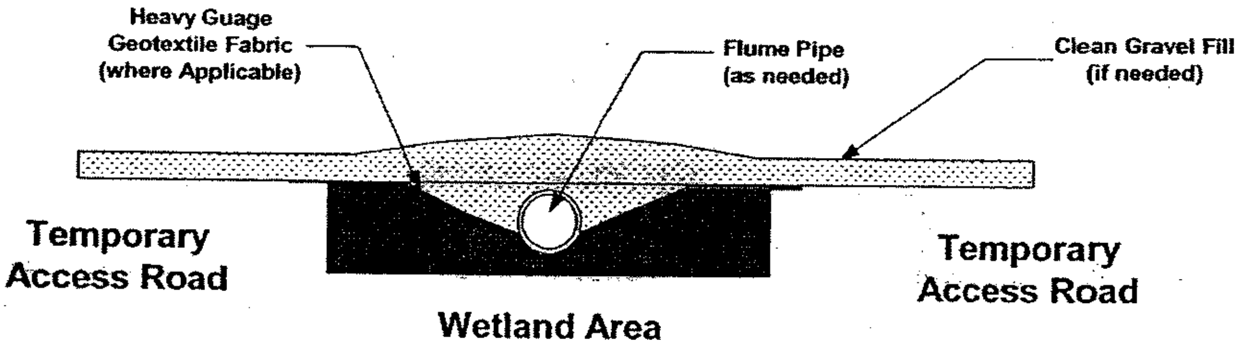




Note: Not to Scale

Maritimes & Northeast Pipeline	**Typical Temporary Access Road With Temporary Flume Pipe Typical Cross-Section**	**Figure 4** **Date: March, 1999**

EV. 04678 4678-33A

All access roads will be surveyed for cultural resources, wetlands and threatened and endangered species, and approved by Maritimes & Northeast and applicable agencies before use is permitted. All temporary access roads will be returned to their pre-construction condition, with the exception of surface improvements in upland areas and culvert replacements. These improvements will be left in place after construction. Any temporary fill placed in wetland areas for improved access must be removed in its entirety after construction.

2.3 Construction Sequence

Maritimes & Northeast pipelines are typically installed using conventional overland buried pipeline construction techniques. These activities are necessary for the installation of a stable, safe, and reliable transmission facility consistent with the FERC and the DOT requirements and regulations. Installation of the proposed pipeline will be performed in a continuous progression that will normally proceed as follows:

- Clearing the construction ROW;
- Installation of erosion controls;
- Grading the construction ROW;
- Trenching/Excavating the trench;
- Pipe stringing and bending;
- Welding and weld inspection;
- Pipe coating;
- Lowering the pipe into the trench;
- Backfilling the trench; and
- Hydrostatic testing, and Restoration of the construction ROW.

These operations, as discussed, are not specific to any project but are presented to give an overview of the equipment and operations necessary for the installation of a pipeline.

2.4 Clearing, Grading and Erosion Controls

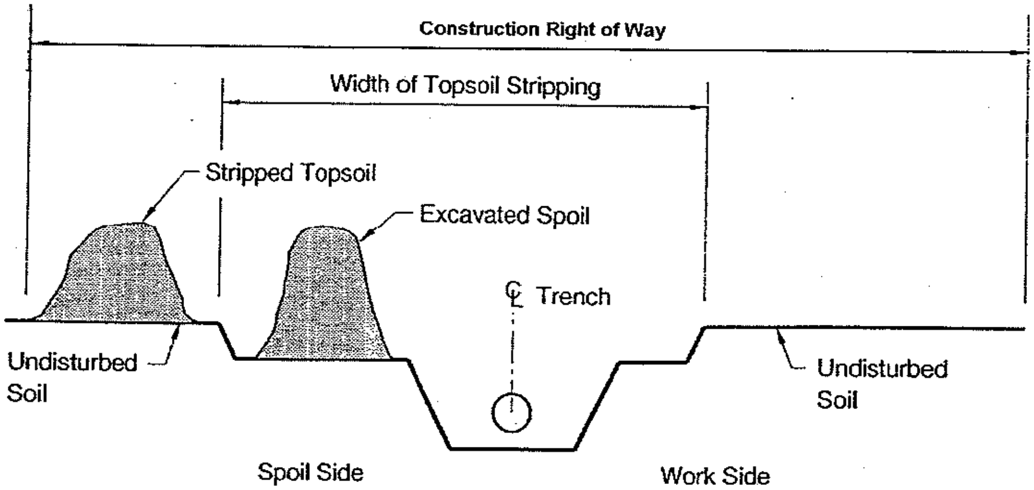
Initial clearing operations will include the removal of vegetation within the construction ROW. Prior to the removal of vegetation, the limits of clearing, wetlands, and no fueling zones will be established and identified. Various clearing methods will be employed depending on tree size, contour of the land, and the ability of the ground to support clearing equipment. As a result, vegetative clearing will either be accomplished by hand or by cutting equipment. During clearing operations, all brush and trees will be felled into the construction ROW to minimize damage to trees and structures adjacent to the ROW. At all waterbody crossings with perceptible flow at the time of clearing, a 25-foot wide ungrubbed area measured back from the top of bank must be maintained until excavation of the trench across the waterbody commences. This standard does not apply to equipment crossings at streams. Large trees will be cut and other vegetation mowed to ground level. All cut trees and branches must be removed from wetlands, waterbodies and riparian zones at the limit of clearing. The contractor may have the option of placing the timber logs on the working side in preparation of building a timber rip-rap roadway to work in wetlands. Each piece of clearing equipment will be limited to one pass through minor streams and wetland areas at the designated equipment crossing location. If the clearing crew requires further passes, an equipment crossing must be installed at the designated equipment crossing location. Equipment crossings must be installed to provide access for other construction equipment. The construction ROW will be cleared in its entirety as specified in the ROW agreements and construction contract. Trees will be chipped, removed, or used as timber rip-rap. Brush, limbs and stumps may be stockpiled along the edge of the ROW, burned or chipped and spread across the ROW in upland areas or disposed of elsewhere depending on applicable regulations and landowner preference. Provisions will be made during to placement of wood products along the edge of the ROW, such as placing gaps, to minimize the disruption of drainage patterns. No brush, wood chips, or cleared material will be permanently placed within wetland areas or waterbodies.

Erosion and sediment control devices will be installed following vegetative clearing operations but prior to grading and trenching in order to insure proper installation. In critical areas such as adjacent to wetlands and streambanks, MEDEP has indicated that sediment barriers (e.g., silt fence or hay bales) must be located between all disturbed areas and wetlands, waterbodies, and other protected resources (for example, identified rare plant locations) unless the land slopes away from the resource. In the case of wetlands and waterbodies, sediment barriers must be located across the ROW between the uplands and these resources. Also, temporary slope breakers will be installed on all disturbed areas, as needed, and on all slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody, wetland, or road crossing. Details on the installation specifications for erosion control devices are provided in Section 5.0.

The construction ROW will then be graded as needed to provide a level workspace for safe operation of heavy equipment used in pipeline construction. As per contract specifications, large rocks will be buried, removed, or placed (windrowed) along the edge of the construction ROW in upland areas with landowner or land managing agency approval. Rock windrows will not be allowed in wetland areas or within 100 feet of perennial Class A, AA, coldwater and coldwater/warmwater waterbodies as depicted on the Waterbody Crossing Table in Appendix E. Where it will be necessary to remove fences, adequate temporary fences or gates will be installed. In upland areas, if grading is required, tree stumps within the proposed permanent ROW will be removed from the work area and abrupt topographical irregularities will be graded to insure rapid and safe passage of the work crews. Stumps may be ground down but will not be removed in the temporary workspace in upland areas unless grading is needed. Generally, machinery will operate on one side of the trench and excavated materials will be stockpiled on the other side of the trench within the cleared width of the construction ROW. Where side-slopes are encountered, the ROW will be graded to provide a level working area. This will require a conventional cut and fill, and will require additional temporary workspace depending on the existing grade.

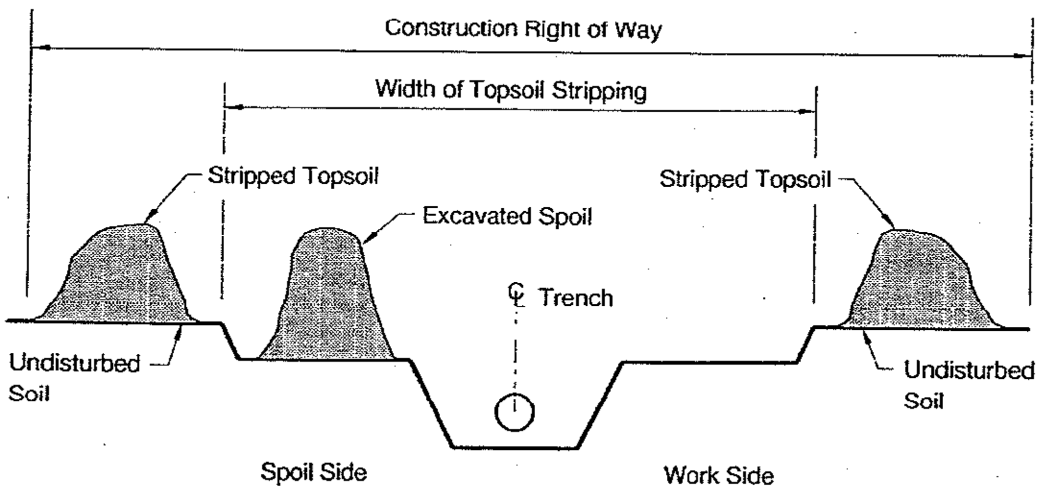
During grading, potential erosion and sedimentation will be minimized in sloped areas by the installation of temporary slope breakers. Refer to Section 5.0 for specifications and spacing requirements.

During grading in upland areas, topsoil will be segregated from subsoil in annually cultivated or rotated croplands, pasturelands, hayfields, residential areas, and in other areas at the landowners' request. Topsoil will be stripped from the entire ROW if grading is necessary to prepare the ROW. If grading is not required, topsoil will be stripped from the trench and spoil side of the ROW (see Figure 5). Topsoil replacement for residential areas (i.e., importation of topsoil) is an acceptable alternative to topsoil segregation. For deep soils, a maximum of 12-inches of topsoil will be segregated.



Ditch Plus Spoilside Topsoil Segregation

N.T.S.



Full Right of Way Topsoil Stripping

N.T.S.

Note: Topsoil will be stored in additional temporary workspace along the construction Right of Way. The amount of additional workspace will depend on depth and method of topsoil segregation.

Maritimes & Northeast Pipeline	Upland ROW Topsoil Segregation Techniques	**Figure 5** Date: March, 1999

ev. 04678 4678-gr2

Following construction in the above areas, an attempt will be made to remove excess rock from the top 12 inches of topsoil so that the density and distribution or rock is similar to adjacent areas not disturbed by construction. The contractor shall refer to the easement restriction list for other possible provision for rock. At a minimum, topsoil will be segregated from the subsoil as specified in the special provisions of the contract documents. Segregated top spoils will not be utilized as backfill material for padding the pipe.

Grading is normally not required in wetland areas. The top 1 foot of topsoil in wetland areas will be segregated from the trenchline and stockpiled separately from the subsoil to the extent possible during the trenching operation, except where standing water, saturated, or frozen soils are present. Following construction, the trench will be backfilled with the topsoil placed on top to restore the soil profiles.

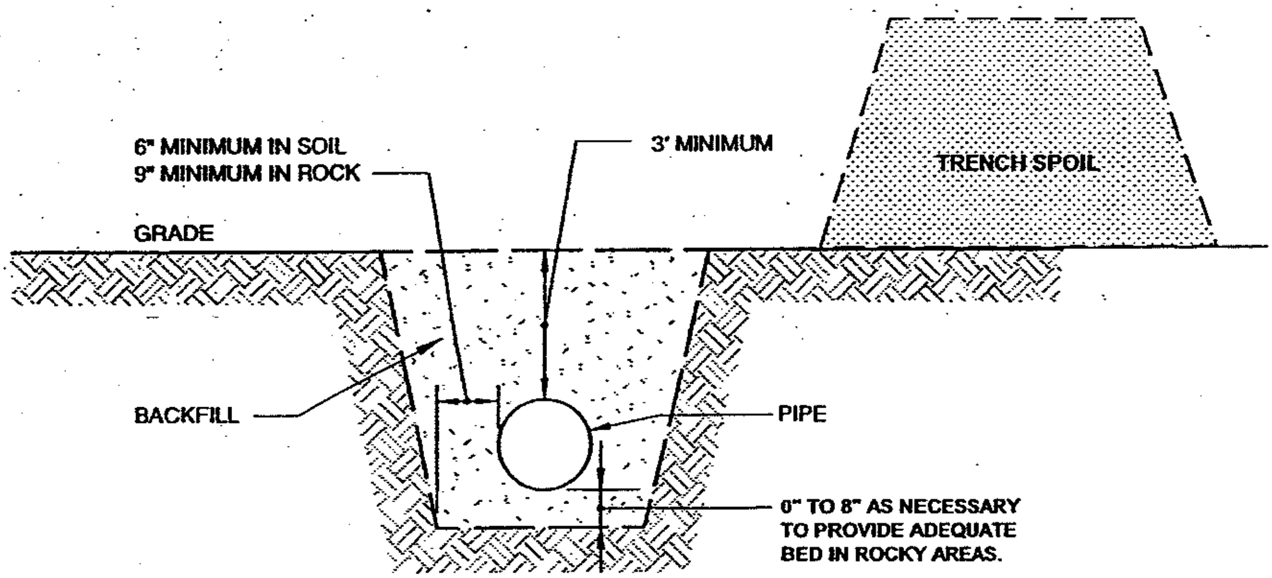
2.5 <u>Trench Excavation</u>

The trench centerline will be staked after the construction ROW is prepared. In general, a trench will be excavated to a depth that will permit burial of the pipe with a minimum of 3 feet of cover, or as otherwise applicable pursuant to DOT regulations under the Natural Gas Pipeline Safety Act (see Figure 6). Drainage systems encountered during trench excavation will be probed to determine if damage has occurred. Drainage tiles damaged during construction will be flagged and repaired to their original condition (see Section 5.1).

In normal terrain the trench will be dug with mechanical backhoes or trenching machines and the excavated material or other stockpiled material will be placed next to the trench. During excavation, on slopes adjacent to wetlands and waterbodies, trench plugs composed of compacted earth will be installed in the trench at the upland and wetland edge to isolate wetlands and waterbody crossings (see Section 5.1). In order to protect waterbodies, the contractor will use structural containment (e.g. earthen berm or equivalent) when excavating soupy or extremely fine soils adjacent to these areas that silt fence cannot adequately filter or support.

Rock may be encountered which is too difficult to excavate with a mechanical backhoe. In these cases, a tractor- mounted tooth, ripper, or hydraulic ram may be employed to loosen or break the material. The backhoe will then remove the rock and soil from the trench.

In areas underlain with bedrock, portions of the pipeline construction may require controlled blasting to grade the ROW and to excavate the trench. Proper safeguards will be taken to protect personnel and property in the area. Ditch spoil, blasting mats and/or other material may be used to prevent the scattering of rock. These activities will strictly adhere to Maritimes & Northeast Blasting Plan (see Appendix H).



CROSS-SECTION VIEW OF TYPICAL TRENCH

N.T.S.

Notes: 1) All original contours will be re-established upon completion of pipe installation. Except in wetlands, a 6 inch crown will be left to account for ditch settling.

2) In coldwater fishery streams, the top 1 foot of the trench will be backfilled with clean gravel or native cobbles.

3) Erosion control will be installed between the trench spoil pile and the waterbody in accordance with the Maritimes & Northeast Soil Erosion and Sediment Control Guidelines.

Maritimes & Northeast Pipeline	Typical Trench Detail	Figure 6 Date: March, 1999

2.6 Pipe Stringing and Bending

Following trench excavation, pipe sections will be delivered from the temporary storage yard to the construction site by truck and strung out along the trench. Side boom tractors will be used to lift the individual pipe sections from the truck and place them within the construction ROW. Individual pipe sections will be placed on temporary supports or wooden skids and staggered to allow for work on the exposed ends. For wetland areas, the pipe sections may be assembled in the wetland if the wetland area is dry enough to adequately support the pipe and skids. Certain pipe sections are then bent, as necessary, to conform to changes in slope and direction of the trench. A hydraulic-mechanical pipe bending machine will be used to bend the pipe to desired angles.

2.7 Pipe Welding and Weld Inspection

Following the bending operation, pipe sections will be welded together using approved welding procedures that comply with Maritimes & Northeast welding specifications. After the welds are complete, the joints are examined on-site by a qualified Nondestructive Testing Technician using approved radiography or ultrasonic inspection methods to ensure structural integrity. If the welds do not meet the requirements established by DOT regulations, they are marked for either repair or replacement.

Each piece of pipe is factory coated with an electrically insulating material. This material provides an inert barrier that prevents current from leaving the steel pipe, thus preventing corrosion of the pipeline. Pipe ends are not coated in the mill to allow for welding. Following welding, the coating crew will install a protective coating over the weld areas and electrically inspect the coating on the pipeline for defects. Repairs will be made if a defect is found in the coating during electrical inspection.

2.8 Lowering-in

Lowering-in consists of placing the completed pipeline sections into the trench where a tie-in weld will be made. Lowering-in will usually be accomplished with two or more sideboom tractors acting in unison and spaced so as not to buckle or otherwise damage the pipe. The pipeline will be lifted from the supports, swung out over the trench, and lowered directly into the trench. At least two sidebooms are required on small pipelines while up to five or six may be used on long, large pipe-diameter projects. The equipment uses a "leap frogging" technique requiring sufficient area to safely move around other tractors within the construction ROW to gain an advanced position on the pipe. This technique progresses until the entire length of pipeline is placed into the trench.

Trench dewatering may be periodically required along portions of the proposed pipeline. The discharge point from trench dewatering will be at least 25 feet from the edge of a stream, river, or lake, be on a slope of less than 20 percent where possible and passed through a non woven filter bag or sediment trap (hay bale, lined pool, etc.). Dewatering structures may at times be located off of the ROW, where possible in vegetated areas. When a filter bag is placed within 250 feet of a waterbody (not wetland), the bag must be surrounded with secondary containment. Trench water must be pumped through a non-woven filter bag or sediment trap before discharging water into the wetland (see Section 5.2). Pump intake hoses will not be allowed to be set on the trench bottom throughout dewatering. In addition, a filter may be attached to the intake hose consisting of a burlap bag or a large perforated bucket filled with washed stone to reduce the intake of suspended solids if settling has not occurred. Care will be taken to insure that natural drainage is not adversely affected.

2.9 Backfilling

Prior to backfilling, the trench will be given a final inspection to insure that all debris has been removed from the trench and that the pipe and pipe coating is undamaged. In areas where the trench bottom is irregularly shaped due to consolidated rock or where the excavated spoil materials are unacceptable for backfilling around the pipe, padding material may be required to prevent damage to the pipe. This will generally consist of sand or screened subsoil spoil materials from trench excavation. Sections of trench that contain water may be pumped to allow inspection. Dewatering effluent will be discharged as previously described (see Section 2.8).

Backfilling consists of covering the pipe with the earth removed from the trench or with other material hauled to the site when the existing trench spoil is not adequate for backfill. Backfilling will follow the lowering of the pipe as close as practical. Any excess excavated material will be spread within the ROW in upland areas. The soil will be graded to pre-existing contours that match adjacent unaltered areas. Topsoil removed from the ROW will then be spread across the graded ROW.

The trench may be backfilled with a slight crown over the pipe where acceptable to the landowner to ensure the complete filling of the trench and to compensate for compaction and settling. Openings will be left in the completed trench crown to restore pre-existing drainage patterns. Crowning will not be used in wetland areas. Trench breakers typically consisting of sandbags (clay saddles or other material may be used in certain instances) will be installed in the trench around the pipe in areas with slopes greater then 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland to provide protection against erosion from water flowing along the pipe in sloped terrain. See Section 5.1 regarding the use of trench breakers.

2.10 Hydrostatic Testing

Maritimes & Northeast has developed a Hydrostatic Test Plan (see Appendix F) for the pipeline that complies with EPA, NPDES and the state of Maine requirements. The following is a discussion of the general hydrostatic test procedures.

Once the pipeline is complete, it will be hydrostatically (water) tested for structural integrity. Hydrostatic testing involves filling a pipeline with good quality water and maintaining a test pressure in excess of normal operating pressures for a specified period of time. The testing procedure basically involves four steps: cleaning of the pipeline, filling with test water, performance of the pressure test, and discharge of the test water. Prior to filling the pipeline with water, a number of cleaning runs may be made to clean the pipe interior. Cleaning is typically accomplished by using compressed air to push a "cleaning pig" through the pipeline. This "cleaning pig" will be propelled through the pipe to remove all residual material prior to testing.

Once cleaning has been completed, a "pig" will be propelled through the pipeline with clean water to perform the test. Filling will be carried out in a manner that completely fills the pipeline with water. Water for testing is typically obtained from fresh flowing streams or other bodies of water crossed by, or near, the pipeline, or a municipal water supply source such as a fire hydrant. Use of municipal water supplies will be coordinated with appropriate local authorities. State-designated exceptional value waters, or streams designated as public water supplies, will not be used unless authorized by State authorities.

If water is obtained from a natural water source, a pump will be placed adjacent to the water body within a hay bale basin with absorbent pads or equivalent secondary containment structure to protect against a fuel leak or spill. The intake pipe will be carefully placed in the water to minimize disturbance of sediments. The water is then pumped into the pipeline through a screen at the inflow end to prevent the entrainment of macroaquatic life. The intake water will be sampled for chemical analysis at the approximate midpoint of the fill operation. The total volume of water required will depend on the size and length of pipe. If a stream is used as the water supply, adequate downstream flow rates will be maintained for all instream uses and withdrawals.

Once the pipe is filled with water, it will be pressurized for a prescribed test period. No chemicals or additives are used in the testing procedure. Upon completion of the test, water will be discharged from the pipeline and sampled at the approximate midpoint of the discharge operation for later chemical analysis. The test water will be discharged at a controlled rate by controlling the volume and pressure of the compressed air that will be used to move the pig that forces the water out of the pipeline. Test water may be discharged out of the pipeline through an energy dissipater that may consist of a baffle pipe within an appropriate erosion control device. Alternatively, test water may be discharged back into the intake source or other body of water through an aeration system, if needed. A discharge pipe with an aeration type energy dissipater allows the test water to be sprayed into the receiving waterbody, thereby preventing erosion and scouring of the bottom sediments.

2.11 Restoration

Restoration efforts including final grading and installation of permanent erosion control devices, will be completed in accordance with the FERC and MEDEP guidelines described in Section 5.2, weather and soil conditions permitting. Restoration efforts including topsoil replacement, final grading, and installation of permanent erosion and sediment control devices will be completed within 20 days after the trench is backfilled, weather and soil conditions permitting. These restorations efforts will be performed within 10 days in all residential areas (specific restoration requirements as defined by the MEDEP will be utilized within 100 feet of waterbodies). All disturbed soils will be seeded within 6 working days of final grading, weather and soil conditions permitting. These guidelines do not apply to temporary equipment crossings and the associated travel lane. All temporary equipment crossings must be removed by November 30 unless otherwise approved on a case-by-case basis by the MEDEP.

During final grading, large rocks will be buried, removed, or windrowed along the ROW with landowner or land managing agency approval. Excess construction debris will be removed from the project site and disposed of at an appropriate location. Excess material will not be buried in wetland areas. Tree stumps removed during construction will be chipped, burned or removed and disposed of at an approved location. Pre-existing drainage patterns, ditches, roads and fences will be restored as near as possible to their former condition. Permanent slope breakers will be installed in accordance with the specifications described in Section 5.0.

Topsoil and subsoil will be tested for compaction at regular intervals in agricultural and residential areas disturbed by construction activities. Tests on the same soil type will be conducted under similar moisture conditions in undisturbed areas to identify approximate preconstruction conditions. Severely compacted soils in agricultural areas will be plowed with a paraplow or other deep tillage implement. In areas where topsoil has been segregated, if needed, the subsoil will be plowed before replacing the segregated topsoil. Alternatively, arrangements may be made with the landowner to plant and plow under a "green manure" crop, such as alfalfa, to decrease soil bulk density and improve soil structure. If subsequent construction and cleanup activities result in further compaction, additional tilling will be conducted. Appropriate soil compaction mitigation in severely compacted residential areas will be performed.

During restoration efforts, the surface will be scarified in preparation for seeding. Revegetation will be accomplished in cooperation with the landowner and in accordance with the specifications detailed in this Section and in Section 5.2. Upland areas within the ROW will be fertilized and limed in its entirety subject to landowners' approval. Applications of woodchips, lime and fertilizer will be prohibited in wetland areas and on streambanks. Seeding and mulching of the ROW will immediately follow final grading and seed bed preparation on slopes greater than 3:1, otherwise seeding will occur within 6 working days of final grading, weather permitting. Appropriate upland and wetland seed mixtures will be used in their respective locations unless the owner prescribes the seed to be used. Specific recommendations on seeding methods, seed mixtures, and rates of application can be found in Section 5.2.

After seeding, all slopes, where needed to stabilize the soil surface, (except in actively cultivated crop land) will be mulched with 2 tons/acre of weed-free straw, hay, or hydromulch to reduce the erosion potential. Mulch will be spread uniformly over the area so that at least 90 percent of the ground surface is covered. High velocity Curlex or jute netting over mulch will be installed on all stream banks to stabilize seeded areas. Curlex, jute netting, or an equivalent will be used over seed and mulch on steep slopes greater than 25 percent to help stabilize the exposed soil.

Once the area is stabilized with vegetation, the erosion control devices will be removed as specified in the permits and contract documents. Occasionally, clean up must be delayed until spring. When this occurs, temporary winterizing measures will be taken to minimize erosion. These measures include stabilizing all disturbed areas and exposed soil surfaces with mulch hay and temporary seeding with annual rye. Erosion and sedimentation control devices will also be installed and maintained as needed. Seeding for permanent cover will be performed at the beginning of the next seeding season If construction activities continue into the winter season, when conditions may delay successful restoration, Maritimes will consult with the FERC and MEDEP and develop a detailed winterization plan.

3.0 WATERBODY CROSSING PROCEDURES

3.1 Introduction

To minimize potential impacts, waterbodies, streams and rivers will be crossed as quickly and safely possible. Adherence to these construction procedures will ensure that stream flow and water quality will be maintained throughout construction. Most stream crossings will be completed using conventional backhoe type equipment and dry crossing techniques. In most instances, except where agency input has required changes, Maritimes is proposing to use the same waterbody crossing techniques approved and used for Phase II construction and the same provision for adjustments to the approved crossing method by the Third Party Inspector, depending on field conditions at the time of the crossing.

There are three perennial surface waterbodies crossed by the project. Two of the crossings are intermediate (greater than 10 and less than or equal to 100 feet in width), and one waterbody, the St. Croix River, is classified as major (greater than 100 feet in width). A table titled *Waterbodies Crossed by the Phase IV Pipeline Project* ("Waterbody Crossing Table") is located in Appendix E which identifies each waterbody crossing by milepost, the associated wetland number, the stream type (perennial or intermittent), the estimated width and depth, the state water quality class, the fishery type (coldwater, warmwater, coldwater/warmwater, unknown), the proposed crossing construction method, the construction timing window and other special site conditions that may apply.

A specific waterbody construction method has been assigned to each waterbody crossing along the Phase IV Project. The application of each crossing method is dependent on the specific characteristics of the waterbody, such as waterbody type/fisheries classification, width, depth and flow of the waterbody, its physical and vegetative characteristics, water quality, the aquatic resources supported by the waterbody, its surface and subsoil composition and the consumptive uses of the surface water located in the Project area.

Waterbodies are separated into three main categories depending on the width of the waterbody at the time of the crossing. The categories and timing requirements for completion of each crossing for this project are defined as follows.

- **Minor Waterbodies** – include all waterbodies less than or equal to 10 feet wide at the waters edge at the time of construction.

- **Intermediate Waterbodies** – include all waterbodies greater than 10 feet wide, but less than 100 feet wide at the water's edge at the time of construction.

- **Major Waterbodies** – include crossings of more than 100 feet wide at the water's edge at the time of construction.

Impacts to water quality will be minimized while work is being performed in streams and other bodies of water by implementing the following measures:

- Construction equipment and materials, fuels, etc., will not be stored within wetlands or within 100 feet of any stream or wetland system, except under limited, highly controlled circumstances.

- Construction equipment will not be refueled within wetlands or within 100 feet of any stream or wetland system, except under limited, highly controlled circumstances and under direct supervision of the Environmental Inspector.

- Equipment will be well maintained and checked daily for leaks.

- Construction equipment will not be washed in any wetland or watercourse along the construction corridor.

3.2 Waterbody Construction Timing Windows

Specific construction timing windows indicate when the pipeline installation can be performed for each waterbody. These windows are directly related to the waterbody type and fisheries classification designated for each waterbody. In general, significant fisheries require construction during specific timeframes while waterbodies not classified as significant fisheries, or waterbodies where the pipeline is installed using horizontal directional drilling, do not have specific construction timing windows.

Table 1 below identifies the appropriate construction timing window for each waterbody type/fisheries classification.

Table 1 is a guideline that was utilized to determine the appropriate construction timing window for each waterbody. Refer to the Waterbody Crossing Table located in Appendix E to identify the specific construction timing windows that have been assigned for the crossings along the Phase IV Project.

TABLE 1. WATERBODY CONSTRUCTION TIMING WINDOWS

Waterbody Type/Fishery Classification	Construction Timing Window
I. Coldwater Fisheries (intermittent or perennial)	**July 1 – September 30**
II. Specific Atlantic Salmon Fisheries selected by the ASC	**July 1 – August 31**
III. Perennial Class AA or A Waterbodies	**June 1 – September 30**
IV. Intermittent Waterbodies Designated Class A, AA with No Fishery Designation	**June 1 – October 31**
V. Warmwater Fisheries	**June 1 – November 30**
VI. All Others	**No Timing Restrictions**

3.3 Waterbody Crossing Methods

There are five waterbody crossing methods that will be used for the Phase IV Project. These methods are described in the following Section and are as follows;

1. Open Trench;
2. Dry Crossing 1 (flumed);
3. Dry Crossing 2 (flumed and/or dam and pump)

4. Dry Crossing 3 (flumed and/or dam and pump)
5. Horizontal Directional Drill (HDD).

The waterbody crossing methods were generally chosen based on the following criteria.

- All perennial coldwater or coldwater/warmwater fishery streams, as designated by the MEDEP or IF&W, must be crossed using the Dry Crossing 1 method, unless a modification is approved by the MEDEP.

- Any perennial Class A or Class AA stream that is designated by MEDEP or IF&W as a fishery stream, must be crossed using the Dry Crossing 1 or 2 method.

- Any perennial or intermittent stream with no flow present at the time of the crossing, may be crossed using the Open Trench method.

- If flow is present in intermittent streams at the time of the crossing and it is a Class A, AA non-designated fishery stream, as determined by MEDEP or IF&W, it may be crossed using the Dry Crossing 2 or 3 method; if flow is present at the time of the crossing and it is a designated fishery stream, as determined by MEDEP or IF&W, it must be crossed using the Dry Crossing 1 or 2 method.

- Intermittent and perennial waterbodies not designated Class A, AA, or coldwater or coldwater/warmwater fisheries may be crossed using the open trench method.

- Waterbodies up to 30 feet wide that are state-designated as either coldwater or significant coolwater or warmwater fisheries shall be crossed using a Dry Crossing 1 or 2 method (unless otherwise approved by the appropriate state agency).

The specific waterbody crossing methods that are identified for each waterbody as shown in the Waterbody Crossing Table, will be utilized unless an alternative method has been approved by the MEDEP. The crossing method procedures are described in Sections 3.3.1 through 3.3.5 and summarized in Table 3. In addition, illustrations of these crossing methods are provided in Figures 7, 8, 9, and 10.

3.3.1 <u>Open Trench Construction Method</u>

In general, the open trench method of construction consists of in water work and digging an open trench in the stream bottom, laying the prefabricated length of pipe necessary to reach bank to bank and backfilling. Construction equipment will be positioned on the banks or in the waterbody itself, and a trench will be excavated across the stream channel. Only the construction equipment needed to complete the waterbody crossing will be allowed in the channel. Excavated material from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings, will be placed at least 10 feet from the waters edge. The excavated material will be placed within a stockpile area within the ROW surrounded by sediment filter devices to prevent siltation of the adjacent resource area. In-stream trenching across the stream bottom will be isolated by the installation of trench plugs or backfill.

A Variance from the Procedures must be obtained from the FERC and approved by the MEDEP Third Party Inspector if side-casting within the channel is required for minor and intermediate crossings due to site-specific construction constraints such a stream width, substrate material, and topography.

If a perennial or intermittent waterbody has a designated dry crossing method but does not have perceptible flow at the time of the crossing, it may be crossed using the open trench method. Otherwise, the dry crossing method must be used. However, if a dry waterbody begins to flow during the crossing, the dry crossing method procedures must be implemented immediately. Also, the construction and restoration timing completion requirements for the type of dry crossing implemented will take effect. Dry crossing methods are discussed in detail below.

3.3.2 Dry Crossing 1 Construction Method

The Dry Crossing 1 method will use a flume pipe to transport the stream across the work area and allow trenching to be done in drier conditions. The flume pipe(s) installed across the trench will be sized to accommodate anticipated stream flows. For a waterbody designated with a Dry Crossing 1 method, the pipe must be lowered into the trench with the flume pipe(s) in place and cannot be removed or replaced with the dam and pump method. Therefore, the Dry Crossing 1 method typically requires installation by a separate stream crossing or tie-in crew ("tie-in crew"), rather than a mainline crew used for normal cross-country construction.

This method starts with stream construction preparation beginning with the initial installation of the flume pipe(s) on sandbags at each end to prevent water from leaking under the pipe into the work area. The openings to the pipe are then sand bagged (diked) around each end. The upstream dike is constructed first to channel the stream flow through the flume. The downstream dike will then be constructed to isolate the work area. Sandbags used during construction will be filled with sand free of silt, organics, and other material. Alternatively, steel plates welded to the flume(s) or other barriers can be used to dam the water instead of sand bags.

Preparation for the stream crossing may begin two days prior to in-stream construction; however, no grubbing within 25 feet, measured horizontally from the water's edge, may occur until just immediately prior to the initiation of trench excavation.

Once the stream construction preparation phase is complete and the stream is flowing fully within the flume pipe(s), the pipeline trench will then be excavated in drier conditions across the channel and under the flume. The pipeline will be pre-fabricated in the construction ROW or additional temporary workspace to a length necessary to span the entire waterbody and its banks. While the pipe segment for the crossing is being readied, construction equipment will be positioned on the banks and a trench will be excavated across the stream channel.

Trench spoil stockpiles will be placed within the construction ROW and may be 10 feet from the edge of the stream if they will be removed within 48 hours. Stockpiles which will remain in place longer than 48 hours must be 25 feet from the edge of the stream and must be mulched within 7 days or prior to any storm event when erosion is likely to occur. Trench plugs (typically constructed of sand bags or unexcavated earth) will be used to isolate that section of trench crossing the stream.

Dewatering of the isolated portion of the stream channel (between the two dams) can be performed to some degree. Under ideal circumstances the soils within this construction area would permit the complete dewatering of the site and a true dry crossing to take place. Any dewatering which takes place shall be conducted as described in the SESCG.

In many cases it will not be possible or desirable to dewater the excavation within the isolated reach due to the presence of soils with high hydraulic conductivity (groundwater discharge) and/or leakage through the dams. Attempting to dewater under these conditions may result in the release of sediment-laden water beyond the immediate area. Although work may be conducted within this isolated water, it is separated from the streamflow and still considered a dry crossing.

Once the trench is complete, the pipe will carried into position and lowered into the trenchline on one side of the flume pipe. The pipeline is then threaded under the flume pipe into its final position within the stream channel at the bottom of the trenchline. The ends of the pre-fabricated pipeline used to cross the waterbody will be left exposed to facilitate tie-ins to the cross-country pipeline.

3.3.3 Dry Crossing 2 Construction Method

The Dry Crossing 2 method, like the Dry Crossing 1 method, may use flume pipe(s) to transport the stream across the disturbed area to allow trenching to be done in drier conditions. The initial flume pipe setup is constructed under the same protocol as described for the Dry Crossing 1. In addition, as part of the Dry Crossing 2 method, the Contractor can use pumps to transport the stream across the proposed trenchline to create drier conditions for trenching (referred to as the dam and pump method). Specific details regarding the dam and pump procedures are provided in Section 3.3.4.

Preparation for the stream crossing may begin two days prior to in-stream construction; however, no grubbing within 25 feet, measured horizontally from the water's edge, may occur until just immediately prior to the initiation of trench excavation.

Once the stream construction preparation phase is complete and the stream is flowing fully within the flume pipe(s), or is being pumped around by the dam and pump method, the pipeline trench will then be excavated in drier conditions across the channel. As described in the Dry Crossing 1 method, dewatering activities may be limited within the isolated reach due to the presence of soils with high hydraulic conductivity (groundwater discharge) and/or leakage through the dams. Although work may be conducted within this isolated water, it is separated from the streamflow and still considered a dry crossing.

For a waterbody designated with a Dry Crossing 2 method, where flume pipe(s) are used, the Contractor may remove the flume pipe(s) for the lowering-in phase. If the flume pipe(s) are to be removed, the dam and pump method must first be in place and operating properly. After lowering-in is complete, either the flume pipe(s) must be replaced, or the dam and pump method must be continued until backfill and final streambed and bank restoration is complete. For a Dry Crossing 2, either the flume pipe(s) or dam and pump method must be in operation from initial trenching activities until the final streambed and bank restoration is complete. Pre-fabrication of a sufficient length of pipe, storage of trench spoil, trench dewatering and placement of the pipe in the trench are essentially the same as for the Dry Crossing 1 method.

Trench spoil stockpiles will be placed within the construction ROW and may be 10 feet from the edge of the stream if they will be removed within 48 hours. Stockpiles which will remain in place longer than 48 hours must be 25 feet from the edge of the stream and must be mulched within 7 days or prior to any storm event when erosion is likely to occur. Trench plugs (typically constructed of sand bags or unexcavated earth) will be used to isolate that section of trench crossing the stream.

3.3.4 Dam and Pump Crossing Procedures

Before the initiation of any in-stream activities, all material associated with the dam and pump site set-up must be on-hand. These materials include, but are not limited to the following:

- water barriers
- downstream splash plate
- pumps (primary and secondary) and hoses
- fuel for pumps (stored at least 100 feet from waterbody)
- spill prevention and control materials (including secondary containment for pumps within 100 feet of wetland or waterbody)

3.3.4.1 Upstream Water Intake/Sump Hole

Once the necessary materials are on-location, site set-up may begin. The first step is to select an appropriate location for the pump intake hose(s) to be positioned. Depending upon the channel characteristics, either a naturally occurring deep spot or channel should be selected as a "sump" or a sump may need to be created to provide sufficient water depth for the screened hose intake(s). If a natural sump is not available for the intake hose, an in-stream sump will be created by excavating within the stream channel and surrounding the excavation using sandbags. Upon completion of the waterbody crossing any sandbags utilized for a sump shall be removed and the stream channel restored to pre-construction condition. The sump shall be of sufficient depth to prevent the entrainment of excessive amounts of sediment into the hose.

3.3.4.2 Pump Set-Up

Pumps shall be fueled prior to placing them in position. If it is necessary to refuel during the pump operation, extra care shall be taken to avoid spillage and spill control materials will be readily available. Secondary containment will be placed under the pumps as an additional precautionary measure to protect against accidental leakage or spill. Fuel for filling the pumps will not be stored within 100 feet of the waterbody. During the assembly of the upstream and downstream water barriers, the pumping network shall be setup to begin the transfer of water around the construction work area.

The pump intake and discharge hoses shall be appropriately placed and of sufficient length, based upon site-specific conditions. The intake hose shall be screened to prevent the entrainment of fish. Discharge hoses shall be provided with support over the ditch-line as needed to prevent excessive sagging and reduction of pumping capacity. If hoses cross the temporary access road, they must be protected from traveling equipment. Additionally, the end of the discharge hose shall be mounted upon a splash plate or similar device or in a manner that will dissipate the energy of the discharging water and reduce and/or eliminate streambed scour.

The number and sizes of pumps to be used at any crossing is dependent upon the volume of water flowing at the time the crossing is made. Pump(s) shall be of sufficient capacity to transfer the entire streamflow around the construction work area. Reserve or backup pump(s) shall be on hand to provide at least 1.5 times the pumping capacity utilized during the initial set-up. When only one "small" pump is used (less than 3-inch hose diameter), a second one shall be available for standby. The typical pump sizes and corresponding volume capacities that will be utilized during construction are listed in the Table 2 below.

TABLE 2. PUMP SIZES AND CAPACITIES

Pump Size (based on intake hose diameter in inches)	Pump Volume (gallon per minute)
2 inches	200 gpm
3 inches	400 gpm
6 inches	700 gpm
8 inches	1,000 gpm
10 inches	1,300 gpm

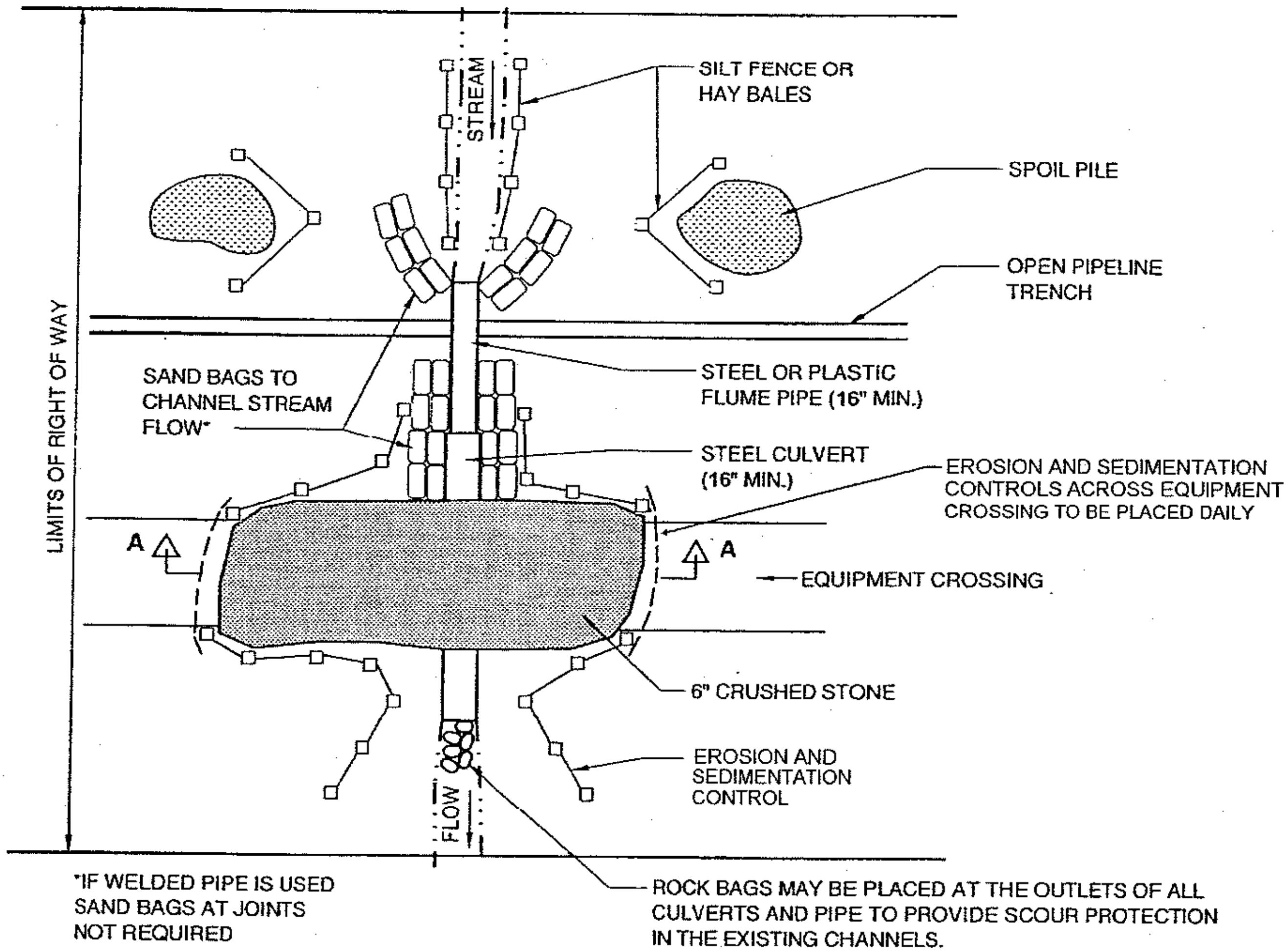
3.3.4.3 Water Barrier Installation

Between the pump hose intake/sump hole area and the trenchline, as well as downstream of the trenchline, dams of relatively impervious material shall be installed. The upstream dam shall be completed first. Dams will be constructed of either sandbags, water bladders, steel plates, Porta-Dams or equivalent and/or "jersey barriers" and plastic sheeting or a combination thereof. Every reasonable effort shall be made to construct the dams as water tight as possible. Additionally, the dams shall be constructed of sufficient height to allow adequate freeboard under reasonably expected water levels/flows and provide for some impoundment of water.

Prior to completion of the dams, the pump(s) must be started in order to provide downstream flow of water around the construction work area. The rate of pumping should be monitored to minimize draining of the intake sump and the resulting cessation in flow. Alternatively, pumping should be monitored and increased as necessary to prevent overtopping of the dams.

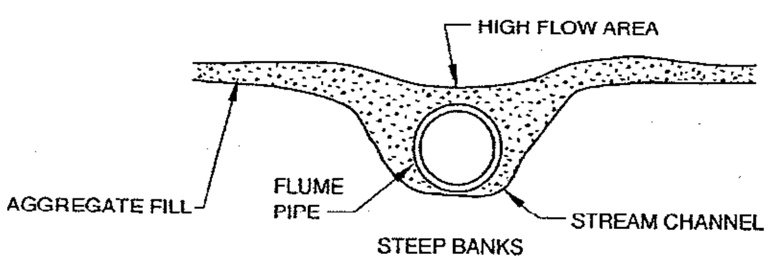
3.3.5 Dry Crossing 3 Construction Method

This construction method was developed to allow a mainline construction crew to prepare long segments of pipeline and lower it in the trench as they typically would for long cross country upland areas. This crossing method is similar to Dry Crossing 1 and 2 in that the crossing will be accomplished using a flume pipe(s) or dam and pump operation (or a combination of the two) as described above. One main distinction for the Dry Crossing 3 method is that the flume pipe(s) can be removed during the pipe lowering operation without substituting the dam and pump method. However, the flume pipe(s) must be replaced (or dam and pump initiated) after the pipe is lowered into the trench and before backfilling. Streambed and bank restoration must be completed while the flume pipe(s) or dam and pump procedures are in place. Another major distinction with the Dry Crossing 3 method is the Construction and Restoration Timing Requirement which is discussed in more detail in Section 3.4.



PLAN VIEW

N.T.S.

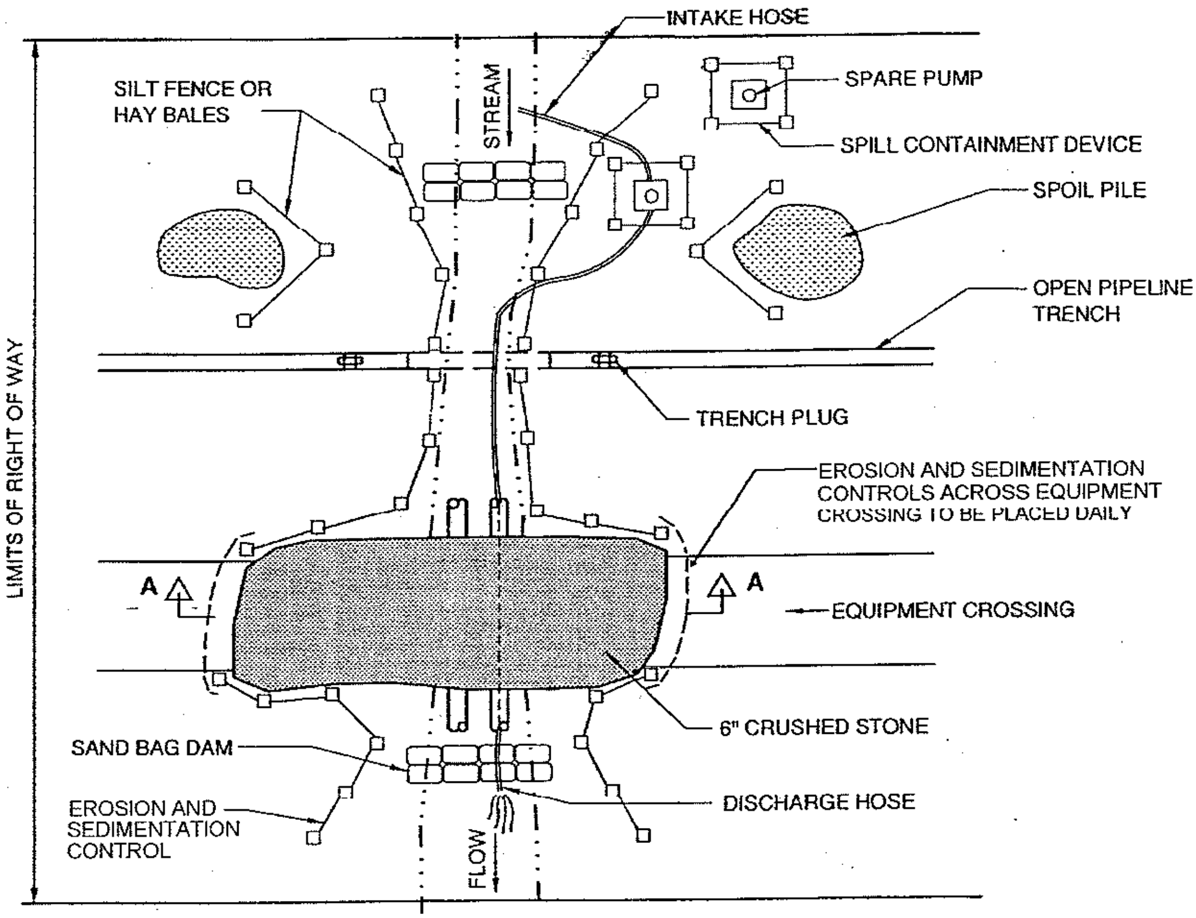


SECTION A-A

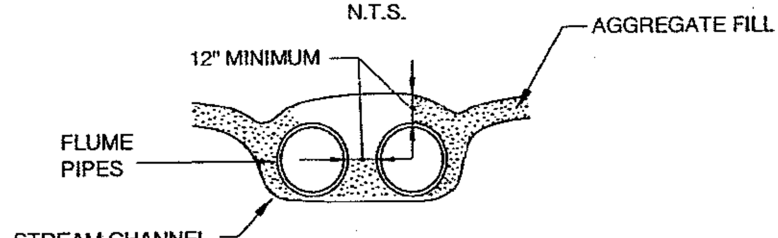
N.T.S.

Maritimes & Northeast Pipeline	Typical Open-Cut Dry Ditch Stream Crossing	Figure 7 Date: March, 1999

ev. 04678 4678-21



PLAN VIEW
N.T.S.



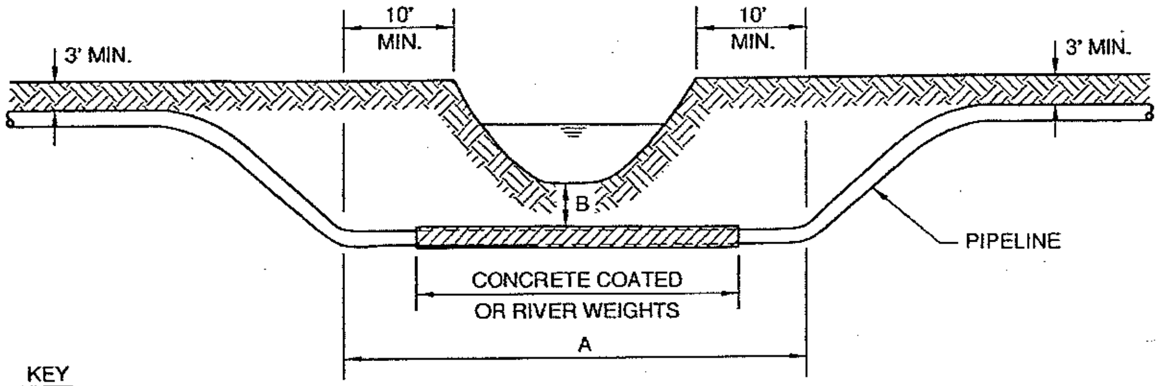
SECTION A-A
N.T.S.

NOTES:

1. EXCAVATE ACROSS STREAM CHANNEL FOLLOWING WATER RE-ROUTING.
2. LOWER PIPE UNDER HOSE AND BACKFILL.
3. MONITOR PUMPS AT ALL TIMES DURING STREAM CROSSING PROCEDURE.
4. REMOVE SILT FENCE/HAY BALES ACROSS EQUIPMENT CROSSING AS NEEDED FOR ACCESS, AND REPLACE AT THE END OF EACH DAY.
5. NUMBER OF FLUME PIPES WILL VARY DEPENDING ON SITE CONDITIONS.

Maritimes & Northeast Pipeline	Typical Dam and Pump Stream Crossing	Figure 8 Date: March, 1999

ev. 04678 4678-34



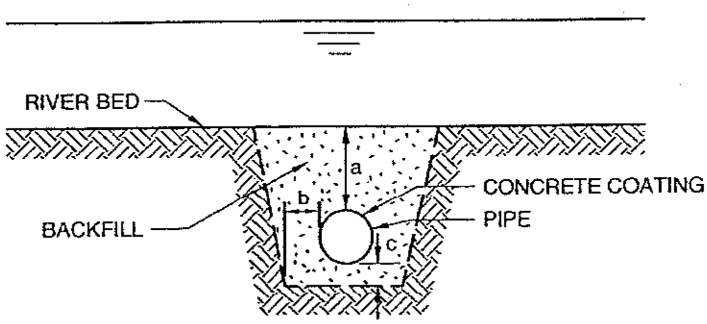
KEY

A = LENGTH OF STRAIGHT PIPE
BELOW RIVER BED VARIES WITH RIVER WIDTH

B = 3' MIN. FOR NONNAVIGABLE RIVERS
4' MIN. FOR NAVIGABLE RIVERS

PROFILE OF RIVER CROSSING

N.T.S.



KEY

a = 3' MIN. FOR NONNAVIGABLE RIVERS
4' MIN. FOR NAVIGABLE RIVERS

b = 6" MIN. IN SOIL
9" MIN. IN ROCK

c = 0" TO 6" TO PROVIDE ADEQUATE BED IF REQUIRED

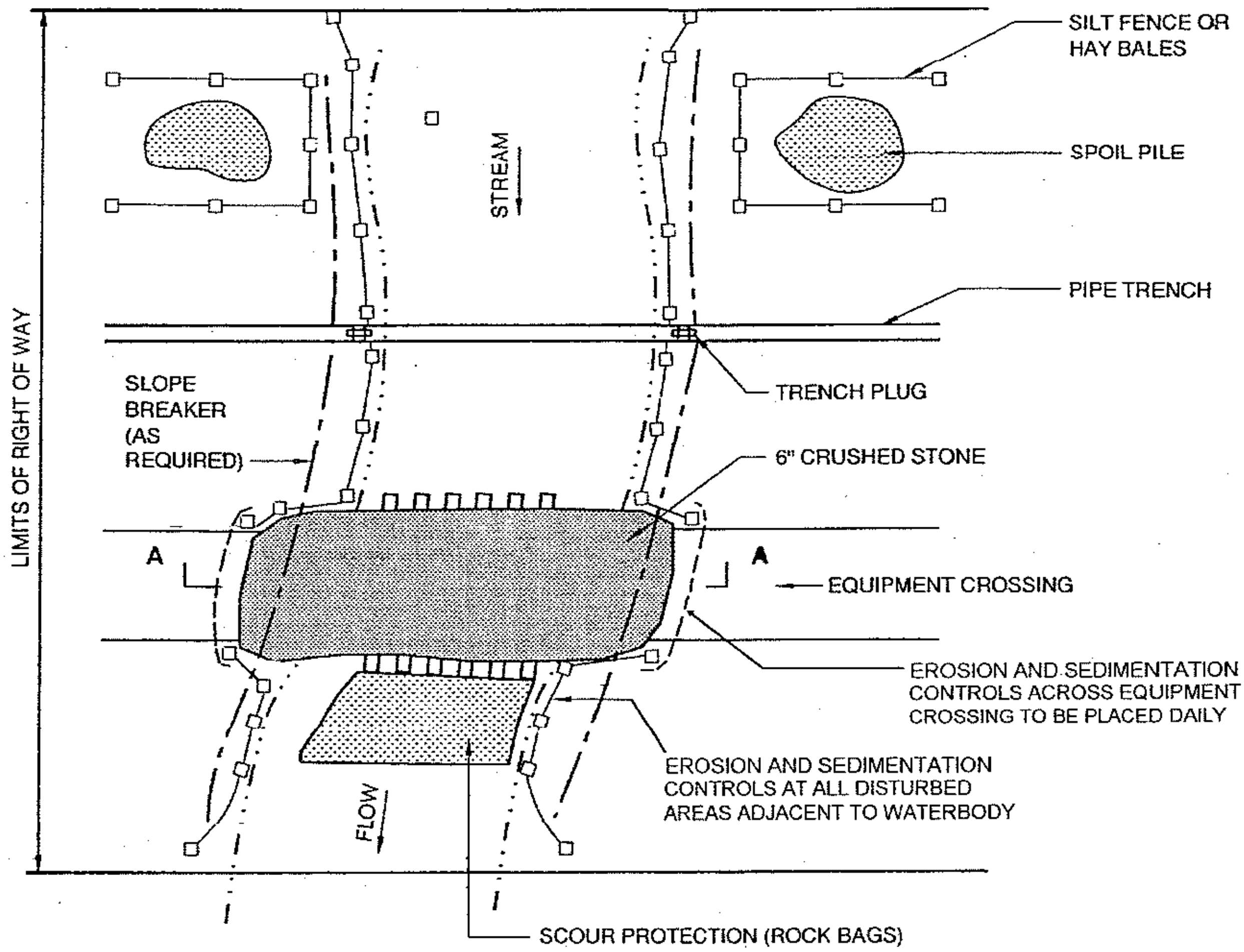
CROSS-SECTION VIEW OF RIVER CROSSING

N.T.S.

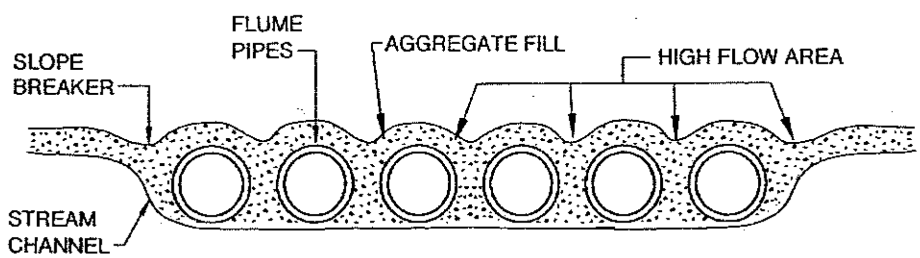
NOTE: BACKFILL TO MATCH ORIGINAL GRADE

Maritimes & Northeast Pipeline	Typical River Crossing Detail	**Figure 9** Date: **March, 1999**

ev. 04678 4678-15



PLAN VIEW
N.T.S.



NOTE: ROCK FILLED BAGS SHALL BE PLACED AT THE OUTLET OF ALL CULVERTS TO PROVIDE SCOUR PROTECTION IN THE EXISTING CHANNELS IF REQUIRED.

SECTION A-A
N.T.S.

Maritimes & Northeast Pipeline	Typical Open-Cut Wet-Ditch Stream Crossing	Figure 10 Date: March, 1999

ev. 04678 4678-20

3.3.6 Horizontal Directional Drill Construction Method

Horizontal directional drilling ("HDD") is a trenchless installation process by which the pipeline is installed beneath obstacles or sensitive areas utilizing equipment and techniques derived from oil well drilling technology. The installation is a multi-stage process consisting of establishing a small diameter pilot hole along the crossing profile, followed by enlargement of the pilot hole to accommodate pull back of the proposed pipeline.

The HDD rig and associated equipment (e.g., control cab, drill string pipe storage, office and tool storage trailers, power generators, bentonite storage, bentonite slurry mixing equipment, slurry pump, cuttings separation equipment, and heavy construction equipment) will be set up on one side of the waterbody crossing. Additional temporary workspace to stage and operate the equipment is identified on the applicable Project Alignment Sheets.

Drilling will progress beneath the waterbody towards the exit target on the other shore. The pilot hole is drilled using a non-rotating small diameter drill string and a drill bit consisting of an asymmetric jetting head. The hydraulic cutting action of the drill head is remotely operated to control its orientation and direction. The position of the drill string is electronically monitored during the drilling operation. Directional corrections are made as necessary to ensure that the drill string maintains the desired profile and alignment.

Bentonite drilling fluid is delivered to the cutting head through the drill string to provide the hydraulic cutting action, lubricate the drill bit, stabilize the hole, and to remove cutting spoil as the drilling fluid returns to the entry point of the pilot hole to an excavated containment pit. Typically, bentonite clay returns are processed to remove the cuttings and the bentonite is recycled for use as the drilling operation continues.

Enlarging the pilot hole is an incremental process accomplished with one to several reaming passes, depending upon the proposed pipeline diameter and the subsurface geology. The rotating reaming/cutting tool is attached to the drill string at the exit point, and drawn back toward the drilling rig situated at the entry point of the pilot hole. Drill pipe is added behind the reaming tool as it progresses toward the drill rig to ensure that a continuous drill string is maintained in the drilled hole. Bentonite drilling fluid is again utilized during the reaming process to remove cutting spoil from the hole.

In the event that a "frac-out" associated with HDD operation is detected, immediate and appropriate action will be taken to assess the situation and to minimize and/or stop the bentonite seepage to the extent practicable. On-land seepage is easily controlled and contained with a variety of materials (lumber shoring, haybales, or earth berms). Water quality and downstream impacts resulting from in-water seepages can be minimized using containment buoys and silt curtains to control turbidity. In certain in-water situations, drilling muds can be pumped (vacuumed) for removal and proper disposal.

Additional temporary ROW will be required along the other side of the waterbody to prefabricate the pipeline into one continuous section in preparation for the pullback. The available workspace for the pull-back operation is also identified on the appropriate Project Alignment Sheet. Once assembled, the pipeline is placed on pipe rollers in order that it may be conveyed into the drill hole during the pull back operation.

The fabricated pipe will be hydrostatically tested prior to pullback. Once reaming is completed, the prefabricated pipeline is attached to the drill string at the exit point, and drawn back toward the drilling rig at the entry location. Upon completion of pipeline construction, the entire line will again be hydrostatically tested. Approved water sources that will be utilized for hydrostatic testing, including HDD pipeline segments, will be identified in the Phase IV Project Hydrostatic Test Plan.

3.4 Construction and Restoration Timing Completion Requirements

The following section provides detailed information regarding the Construction and Restoration Timing Completion Requirements ("CRTCRs") that apply to each waterbody crossed along the Phase IV Project. The CRTCRs provide specific durations for when a waterbody crossing must be completed depending on the initiation or completion of specific construction operations. CRTRs do not apply to the waterbodies where the pipeline is installed using a horizontal directional drill.

For the purpose of discussing the CRTCRs, each waterbody crossing will involve the completion of two tasks. The first task is the completion of the "In-Stream Construction", which includes trenching, lowering-in, backfilling and final restoration of the streambed. The second task involves completion of construction within the waterbody "Restoration Zone" which includes completing final grading, replacement of topsoil, seeding and mulching within all areas of the ROW except the travel lane within 100 feet from the top of the stream banks.

The waterbody crossing method is the initial factor that determines the applicable CRTCRs for each waterbody. Other factors include; the size of the waterbody; blasting requirements; whether a waterbody is perennial or intermittent; whether flows are present at the time of the crossing; and whether installation is performed by a conventional mainline crew or by a separate stream crossing/tie-in crew. All waterbodies have designated as either perennial or intermittent based on pre-construction surveys. This designation is shown in the Table 3 below. The condition of the waterbody at the time of construction (i.e., flowing vs. dry) does not change whether the waterbody is perennial or intermittent classification as identified in the Table 3.

TABLE 3. WATERBODY CROSSING METHODS SUMMARY

Crossing Methods	Crossing Method Description Summary
(I) Open Trench:	*Standard Open Trench methodology.*
II) Dry Crossing 1:	*Flume pipe(s) crossing.* • **All** in-stream activity must take place with flume(s) procedures in place (except blasting). • Do **not** remove flume pipe(s) during lowering in or streambed and bank restoration.
III) Dry Crossing 2:	*Flume pipe(s) crossing or dam and pump method (or a combination of the two).* • **All** in-stream activity must take place with flume(s) or dam and pump procedures in place (except blasting).

TABLE 3. WATERBODY CROSSING METHODS SUMMARY	
Crossing Methods	**Crossing Method Description Summary**
	• If flume pipe(s) are used, flume pipes may be removed during lowering in **only** if replaced with the dam and pump method **prior** to removing the flume pipe(s). • The flume pipe(s) must be replaced, or the dam and pump method must be continued after lowering in. • Streambed and bank restoration must be completed while the flume pipe(s) or dam and pump procedures are in place.
IV) Dry Crossing 3:	***Flume pipe(s) crossing or dam and pump method (or a combination of the two).*** • The flume pipe(s) can be removed during lowering in without substituting the dam and pump method. • The flume pipe(s) must be replaced (or dam and pump initiated) after the pipe is lowered into the trench and **before** backfilling. • Streambed and bank restoration must be completed while the flume pipe(s) or dam and pump procedures are in place.
V) Horizontal Directional Drill:	***Standard Horizontal Directional Drill methodology.***
VI) MEDEP Third Party:	Maritimes' Chief and/or Environmental Inspectors will consult with Maine DEP to decide between an Open Trench or Dry crossing method based on conditions at the time of construction.

The two factors that trigger the start of the CRTCRs window are either (1) the initiation of trenching activities or (2) completion of backfill, depending on site-specific conditions as described in the section below. Additional considerations also apply when blasting activities are required. Blasting considerations are discussed in Section 3.5. The CRTCRs are also summarized in Table 4.

3.4.1 Open Trench CRTCRs

3.4.1.1 Perennial – Flowing

When the open trench construction method is used for a perennial waterbody that has flow present during the time of construction, the timing requirement depends on the size of the waterbody. To complete an open trench on a flowing perennial minor waterbody, the In-stream Construction must be completed within 24 hours of initiating trenching. The Restoration Zone must be completed within 72 hours of initiating trenching. To complete an open trench on a flowing perennial intermediate waterbody, an additional 24 hours is added to each task. Therefore, the In-stream Construction must be completed within 48 hours of initiating trenching and the Restoration Zone must be completed within 96 hours of initiating trenching. Due to the limited timing available to complete the crossing, a separate tie-in crew, rather than a mainline crew, is required for construction.

3.4.1.2 *Intermittent or Non-Flowing Perennials*

For intermittent waterbodies, or waterbodies identified as perennial that do not have flow present during the time of the construction crossing, and designated for an open trench, the contractor has the option to use either a conventional mainline crew rather than a separate tie-in crew. The specific CRTCRs depend on the size of the waterbody as well as whether the installation is performed by a mainline crew or separate stream crossing/tie-in crew.

3.4.1.3 *Tie-In Crew*

As with perennial minor waterbodies, if the contractor chooses to install the crossing with a separate tie-in crew, the In-stream Construction must be completed within 24 hours of initiating trenching. The Restoration Zone must be completed within 72 hours of initiating trenching. For intermediate waterbodies, an additional 24 hours is added to each task and the In-stream Construction must be completed within 48 hours of initiating trenching and the Restoration Zone must be completed within 96 hours of initiating trenching.

3.4.1.4 *Conventional Mainline Crew*

If the contractor chooses to install an intermittent or non-flowing perennial stream crossing designated for the Open Trench method with a conventional mainline crew, the contractor must follow certain steps. The contractor must install a flume pipe(s) before initiating trenching if there is flow in the waterbody. If there is no flow in the waterbody, the contractor must install a flume pipe(s) immediately after trenching. When the mainline crew is performing the lowering-in process, the flume pipe(s) can be removed to allow the pipeline to be placed within the trench. After the pipeline is lowered in, the flume pipe(s) must be replaced. The contactor must complete the backfill operation with the flume pipe(s) in place.

If the contractor chooses to install an intermittent or non-flowing perennial stream crossing designated for the Open Trench method with a conventional mainline crew, the start of the CRTCRs window is triggered upon completion of the backfilling operation (rather than initial trenching). In these instances, for minor crossings, the streambed and banks must be restored within 24 hours of completing backfilling, and the Restoration Zone must be completed within 48 hours of completing backfilling. For intermediate crossings, the streambed and banks must be restored within 48 hours of completing backfilling, and the Restoration Zone must be completed within 72 hours of completing backfilling.

For certain waterbody crossing methods (e.g. Dry 1 and Dry 2), there are certain timing restriction regarding when the Contractor is allowed to set-up the flume pipe(s) for the waterbody crossing. For an Open Trench waterbody crossing constructed by the mainline crew, there are no timing restrictions for setting up the flume pipe(s).

3.4.2 **Dry Crossing 1 and Dry Crossing 2 CRTCRs**

The CRTCRs windows for the Dry Crossing 1 method and the Dry Crossing 2 method are the same and based on the size of the waterbody.

3.4.2.1 Minor Waterbodies

To complete a Dry Crossing 1 or Dry Crossing 2 installation on a minor waterbody, the In-stream Construction must be completed within 24 hours of initiating trenching. The Restoration Zone must be completed within 72 hours of initiating trenching.

3.4.2.2 Intermediate Waterbodies

To complete a Dry Crossing 1 or Dry Crossing 2 installation on an intermediate waterbody, an additional 24 hours is added to each task. Therefore, the In-stream Construction must be completed within 48 hours of initiating trenching and the Restoration Zone must be completed within 96 hours of initiating trenching. Due to the limited timing available to complete the crossing, a separate tie-in crew, rather than a mainline crew, is required for construction.

On Dry Crossing 1 and Dry Crossing 2 waterbody crossings, the Contractor is permitted to set up for the waterbody crossing a maximum of 2 days prior to the day of the crossing (except where blasting is required, see Section 3.5 for additional information for waterbodies that require blasting). Set up includes installation of flume pipes, but does not include bank excavation unless authorized by the MEDEP.

3.4.3 Dry Crossing 3 CRTCRs

The CRTCRs windows for the Dry Crossing 3 method are very similar to that of the Open Trench method. The largest difference is that there is no distinction as to whether a stream is listed as perennial or intermittent, however, certain construction requirements still apply depending on whether the stream has flow or is dry at the time of construction.

As with the Open Trench method, the contractor has the option to use a conventional mainline crew rather than a separate stream crossing/tie-in crew for streams designated with the Dry Crossing 3 method. The specific CRTCRs depend on the size of the waterbody as well as whether the installation is performed by a mainline crew or separate stream crossing/tie-in crew.

3.4.3.1 Tie-In Crew

If the contractor chooses to install the crossing with a separate tie-in crew, for minor waterbodies, the In-stream Construction must be completed within 24 hours of initiating trenching. The Restoration Zone must be completed within 72 hours of initiating trenching. For intermediate waterbodies, an additional 24 hours is added to each task and the In-stream Construction must be completed within 48 hours of initiating trenching and the Restoration Zone must be completed within 96 hours of initiating trenching.

On Dry Crossing 3 waterbody crossings performed by a separate tie-in crew, the Contractor is permitted to set up for the waterbody crossing a maximum of 2 days (except where blasting is required) prior to the day of the crossing. Set up includes installation of flume pipes, but does not include bank excavation unless authorized by the MEDEP.

3.4.3.2 *Conventional Mainline Crew*

If the contractor chooses to install a stream crossing designated for the Dry Crossing 3 method with a conventional mainline crew, the contractor must follow certain steps. The contractor must install a flume pipe(s) before initiating trenching if there is flow in the waterbody. If there is no flow in the waterbody, the contractor must install a flume pipe(s) immediately after trenching. When the mainline crew is performing the lowering-in process, the flume pipe(s) can be removed to allow the pipeline to be placed within the trench (replacing with the dam and pump method is not necessary). After the pipeline is lowered in, the flume pipe(s) must be replaced. The contactor must complete the backfill operation with the flume pipe(s) in place.

If the contractor chooses to install stream crossings designated for the Dry Crossing 3 method with a conventional mainline crew, the start of the CRTCRs window is triggered upon completion of the backfilling operation (rather than initial trenching). In these instances, for minor crossings, the streambed and banks must be restored within 24 hours of completing backfilling, and the Restoration Zone must be completed within 48 hours of completing backfilling. For intermediate crossings, the streambed and banks must be restored within 48 hours of completing backfilling, and the Restoration Zone must be completed within 72 hours of completing backfilling.

For certain waterbody crossing methods (e.g. Dry 1 and Dry 2), the Contractor is permitted to install flume pipe(s) for the waterbody crossing a maximum of 2 days (except where blasting is required) prior to the day of the crossing. For a Dry Crossing 3 waterbody crossing constructed by the mainline crew, there is no timing requirement for setting up the flume pipe(s).

3.5 Blasting Considerations for Waterbody Crossings

3.5.1 Blasting Overview

Blasting operations performed at waterbodies are typically conducted by a mainline blasting crew. The mainline blasting crew moves independently and ahead of the actually pipeline installation procedures. Part of the mainline blasting operation is blasting the trenchline, which includes the trenchline across waterbodies. Where a Dry Crossing method is required to install the pipeline across a stream channel, blasting operations are performed prior to the set-up of the Dry Crossing procedures.

Rock drills may test the ditch-line during mainline blasting operations to evaluate the presence of rock in the trench line. For testing, and subsequent blasting operations, streamflow will be maintained through the site. This will aid in the preparation for the crossing. The excavation of the test pit or rock drilling does not trigger the time windows for completing the crossing.

For these underwater areas, blasting will be conducted in areas of dense till or bedrock that cannot be avoided. It will be conducted using inserted delays of a fraction of a second per hole, and stemming, in which rock is placed into the top of the borehole to dampen the shock wave reaching the water column. The nature of the material that will require blasting, the limited areas where this will be required, and the short duration of this activity will combine to minimize the amount of fine-grained material that will be released into the water column.

Blasting activities do not trigger the start of the CRTCRs. When blasting is required, the CRTCRs that are triggered by Initial Trenching activities begin when the removal of blast rock from the waterbody is started for the pipeline installation. If blasting impedes the flow of the waterbody, adequate blast rock must be removed immediately upon the completion of blasting in order to restore normal flow. Removal of blast rock that impedes normal stream flow can be performed with a backhoe/excavator without triggering the start of the CRTCRs window.

After trenching of the blast rock, if additional blasting is required, new CRTCRs will be determined in consultation with the MEDEP Third Party Inspector.

3.5.2 Provisions for the Removal of Overburden

When the Blasting Contractor encounters a waterbody that has a stream channel with sediment materials overlying the bedrock (overburden), certain provisions are available as an option to allow removal of that overburden prior to performing the blasting operation. This option is available for all waterbodies that will be crossed using any Dry Crossing method.

When the Blasting Contractor chooses the option to remove overburden material from a waterbody designated for a Dry Crossing method, the following procedures will apply, as approved by MEDEP for the Dry Crossing 2 method during construction of the Phase II Project.

- Step 1: Establish the dam and pump;
- Step 2: Excavate the overburden from the streambed;
- Step 3: Store the overburden at least 25 feet from the top of the streambank;
- Step 4: Drill and blast streambed as necessary;
- Step 5: Smooth the blast rock as needed to properly install flume pipe(s);
- Step 6: Reestablish the stream flow through flume pipe(s) until the waterbody crossing crew reaches stream.

It is important to note, the most significant requirement when exercising the option is that the flume pipe(s) that is installed after the blasting operation is completed can be left in place no longer than 7 days prior to initiating the waterbody crossing. Therefore, close coordination will be required between the blasting crews and the waterbody crossing crews to insure that if the blasting crew removes the overburden and installs the flume(s) after blasting, the waterbody crossing crew can initiated the crossing within 7 days.

For Dry Crossing methods (except the Dry Crossing 3 performed by a mainline crew) where blasting is not required, the Contractor is permitted to set up for the waterbody crossing only a maximum of 2 days prior to the day of the crossing. The provisions that have been established for the removal of overburden material allow additional time between the flume pipe(s) set-up and the initiation of the waterbody crossing.

TABLE 4. CONSTRUCTION AND RESTORATION TIMING COMPLETION REQUIREMENTS

- Designated crossing method, stream type, and stream width are identified on the Waterbody Table and the Construction Alignment Sheets. These documents should be reviewed carefully to ensure the proper crossing method and timing requirements are met for each stream category.

BLASTING CONSIDERATIONS

- The below Construction and Restoration Timing Completion Requirements apply except where blasting is required. Detailed Blasting information is Included in Section 3.5 of the SESCG.

Designated Crossing Method		Construction and Restoration Timing Completion Requirements
Open Trench		***Perennial (with perceptible flow at the time of construction)***
		Minor (<10 foot wide) Waterbodies • In-stream construction[1] completed within 24 hours of initial trenching activities. • Restoration zone[2] completed within 72 hours of initial trenching activities. **Intermediate (10 foot – 100 foot wide) Waterbodies** • In-stream construction[1] completed within 48 hours of initial trenching activities. • Restoration zone[2] completed within 96 hours of initial trenching activities.
		Intermittent (or streams listed as perennial that do not have perceptible flow at the time of construction)
		Minor (<10 foot wide) Waterbodies - *One of the following methods must be applied:*
	Mainline Crew	Construction with Mainline Crew • Flume installed before trenching (if flow is present or immediately after trenching if stream is dry) • Trench excavated by mainline crew • Pipeline lowered in by mainline crew (flume pipe may be removed during lowering in operations (for flowing or dry streams) and replaced after lowering in and before backfilling). • Pipeline backfilled by mainline crew. • Streambed and banks restored within 24 hours of the completion of backfilling. • Restoration zone[2] completed within 48 hours from the completion of backfilling.
	Tie-In Crew	Construction takes place with Tie In or Stream Crossing Crew • Tie-in crew completes in-stream construction[1] within 24 hours of initial trenching activities. • Restoration zone[2] completed within 72 hours of initial trenching activities.
		Intermediate (10 foot -100 foot wide) Waterbodies - *One of the following methods must be applied:*
	Mainline Crew	Construction with Mainline Crew • Flume installed before trenching (if flow is present) or immediately after trenching (if stream is dry) • Trench excavated by mainline crew. • Pipeline lowered in by mainline crew (flume pipe may be removed during lowering in operations for flowing or dry streams and replaced after lowering in and before backfilling). • Pipeline backfilled by mainline crew. • Streambed and banks restored within 48 hours of the completion of backfilling. • Restoration zone[2] completed within 72 hours from the completion of backfilling.
	Tie-In Crew	Construction with Tie In or Stream Crossing Crew • Tie-in crew completes in-stream construction[1] within 48 hours of initial trenching activities. • Restoration zone[2] completed within 96 hours of initial trenching activities.
Dry Crossing 1 & Dry Crossing 2		***Perennial or Intermittent***
		Minor (<10 foot wide) Waterbodies • Stream construction preparation (flume installation, site preparation) may be started two days prior to in-stream construction. • In-stream construction[1] completed within 24 hours of initiation of trenching activities • Restoration zone[2] completed within 72 hours of initiation of trenching activities **Intermediate (10 foot – 100 foot wide) Waterbodies** • Stream construction preparation (flume installation, site preparation) may be started two days prior to in-stream construction. • In-stream construction[1] completed within 48 hours of initiation of trenching activities • Restoration zone[2] completed within 96 hours of initiation of trenching activities
Dry Crossing 3		***Perennial or Intermittent***
		Minor (<10 foot wide) Waterbodies - *One of the following methods must be applied:*
	Mainline Crew	Construction with Mainline Crew • Flume installed before trenching (if flow is present) or immediately after trenching if stream is dry) • Trench excavated by mainline crew • Pipeline lowered in by mainline crew (flume pipe may be removed during lowering in operations (for flowing or dry streams) and replaced after lowering in and before backfilling) • Pipeline backfilled by mainline crew • Streambed and banks restored within 24 hours of the completion of backfilling • Restoration zone[2] completed within 48 hours from the completion of backfilling
	Tie-In Crew	Construction with Tie In or Stream Crossing Crew • Tie-in crew completes in-stream construction[1] within 24 hours of initial trenching activities. • Restoration zone[2] completed within 72 hours of initial trenching activities.
		Intermediate (10 foot -100 foot wide) Waterbodies - *One of the following methods must be applied:*
	Mainline Crew	Construction with Mainline Crew • Flume installed before trenching (if flow is present) or immediately after trenching (if stream is dry) • Trench excavated by mainline crew • Pipeline lowered in by mainline crew (flume pipe may be removed during lowering in operations (for flowing or dry streams) and replaced after lowering in and before backfilling) • Pipeline backfilled by mainline crew • Streambed and banks restored within 48 hours of the completion of backfilling • Restoration zone[2] completed within 72 hours from the completion of backfilling.
	Tie-In Crew	Construction with Tie In or Stream Crossing Crew • Tie-in crew completes in-stream construction[1] within 48 hours of initial trenching activities. • Restoration zone[2] completed within 96 hours of initial trenching activities.

1. **In-stream Construction** activities include trenching, lowering in, backfilling, and final restoration of the streambed. Banks returned to pre-construction contours or to a stable angle as approved by the Environmental Inspector. No grubbing of the 25 foot buffer zone may take place until immediately before trench excavation.
2. **Restoration Zone** completion includes final grading, replacement of topsoil, seeding and mulching within 100 feet from the top of stream banks.

3.6 Equipment Crossings

Except where reasonable alternative access is available, construction equipment crossings will be installed across all waterbodies to gain continuous access along the ROW for construction operations. Equipment crossings will be carefully installed to minimize streambed disturbance and downstream siltation. Measures such as large rocks or rock bags will be used in waterbodies with a sandy bottom to prevent the culverts from shifting or rolling. Devices will also be placed at the outlet to the culverts to prevent scouring of the stream bottom where necessary. After such equipment crossings are established, construction equipment will not be permitted to drive through the waterbody. Once the equipment crossing is installed, only the equipment necessary to construct the pipeline crossing will be allowed in the waterbody. The equipment crossings will be removed once access in the area is no longer needed.

As indicated on the Waterbody Crossing Table, for coldwater fishery streams, (which may include Class A and AA streams), water flows and fish passage must be maintained anytime the equipment crossing is in place prior to June 1 or after September 15. Also (as indicated on the Waterbody Crossing Table), for some waterbodies, Maritimes is required to maintain water flows and fish passage at all times. Any of the methods specified below are acceptable. Fish passage must not be blocked. Culverts must be of sufficient size to pass anticipated water volumes from a 25-year storm event. All equipment crossings must be designed to prevent soil from falling into the waterbody.

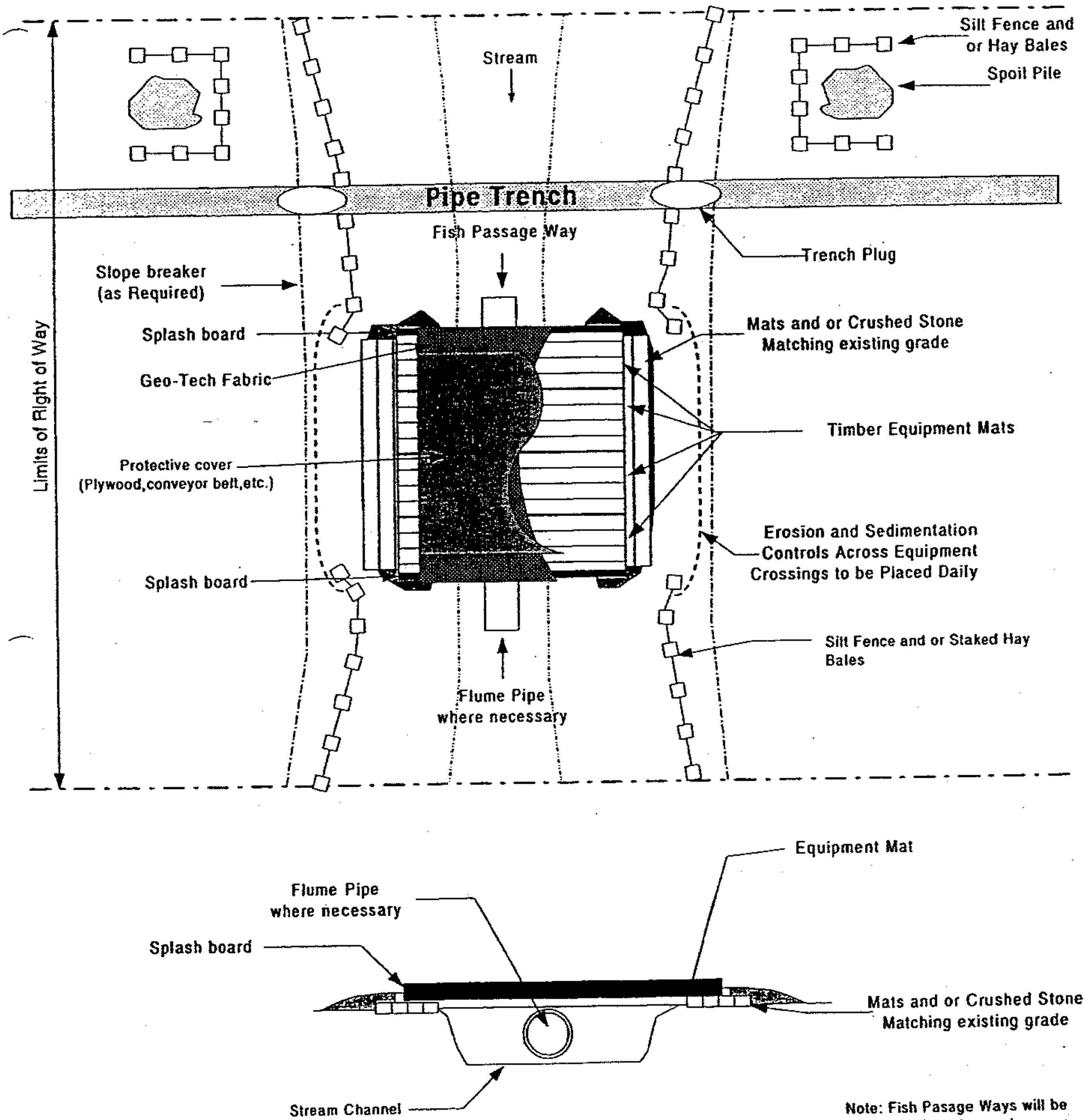
All temporary equipment crossings must be removed by November 30 unless otherwise approved on a case-by-case basis by the MEDEP. Construction equipment must cross waterbodies on bridges consisting of one of the following:

- Clean rockfill and culverts;
- Wooden equipment mats and/or culverts;
- Clean rock fill equipment crossings must be maintained periodically to remove soil from the rocks and to replace additional clean rock if needed; or
- Flexi-float or portable bridge.

To maintain fish passage the typical equipment crossing types shown as Figures 11, 12, and 13 can be utilized. If a different method is used the flume pipe(s) must be sized (25-year storm) and positioned so that fish passage is not blocked.

With respect to equipment crossings containing intermediate supports that are to be placed in waterbodies, the MEDEP requires the following:

- Uncured concrete shall not be placed directly into the water. Concrete shall be precast and cured at least 3 weeks before placing in the water, or where necessary, shall be placed in forms and cured at least 1 week before the forms are removed. No washing of tools forms, etc. shall occur in or adjacent to the waterbody.
- Wood treated with creosote or pentachlorophenol shall not be used below the normal high water line.
- The use of untreated lumber is preferred. Lumber pressure treated with chromated copper arsenate ("CCA") may be used provided it is cured on dry land in such a manner as to expose all surfaces to air for a period of at least 21 days prior to construction.



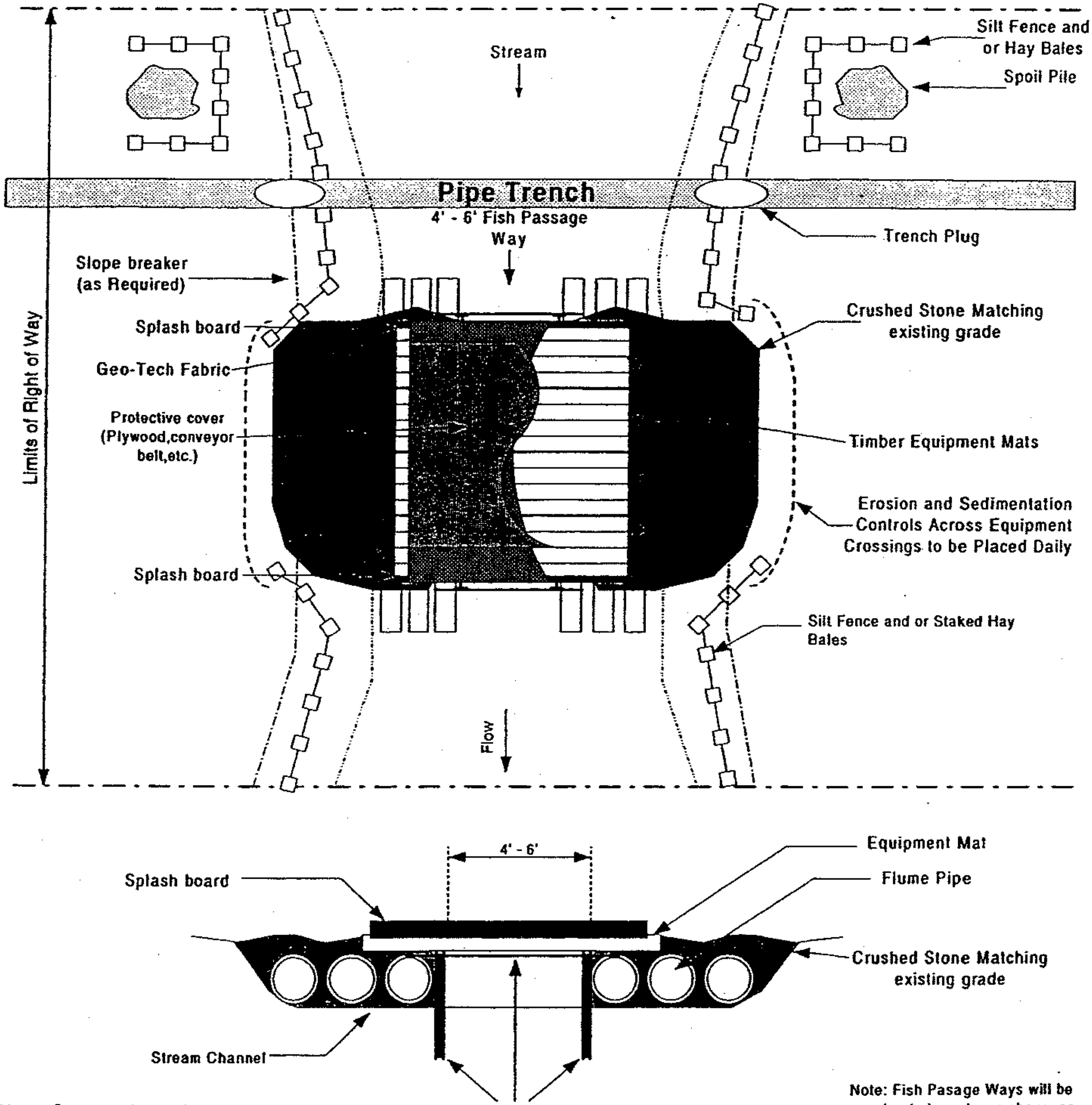
Note: Fish Pasage Ways will be constructed as shown above, or in a similar manner that will prevent soil from entering the waterbody.

Note: Not to Scale

Note: Stream channel and banks will be restored as close as practical to there original condition following installation of pipeline.

Maritimes & Northeast Pipeline L.L.C.

2/10/99	Typical Fish Passage Way - Minor Waterbody Crossing	Figure 11	Dwn By: SJH March 1999

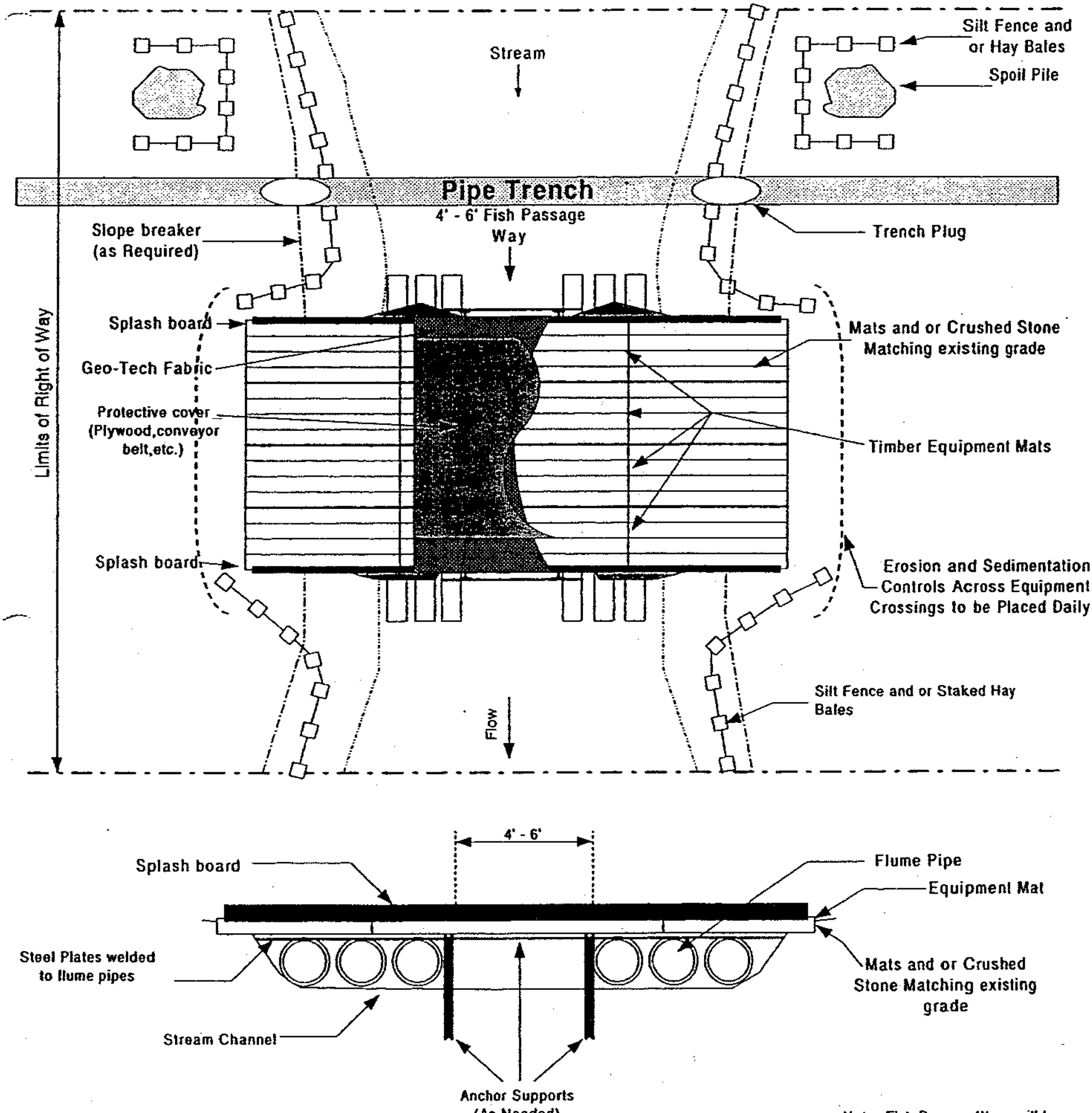


Note: Stream channel and banks will be restored as close as practical to there original condition following installation of pipeline.

Note: Fish Pasage Ways will be constructed as shown above, or in a similar manner that will prevent soil from entering the waterbody.

Note: Not to Scale

Maritimes & Northeast Pipeline L.L.C.			
2/10/99	Typical Fish Passage Way - Intermediate Waterbody Crossing A	Figure 12	Dwn By: SJH March 1999



Note: Stream channel and banks will be restored as close as practical to there original condition following installation of pipeline.

Note: Fish Pasage Ways will be constructed as shown above, or in a similar manner that will prevent soil from entering the waterbody.

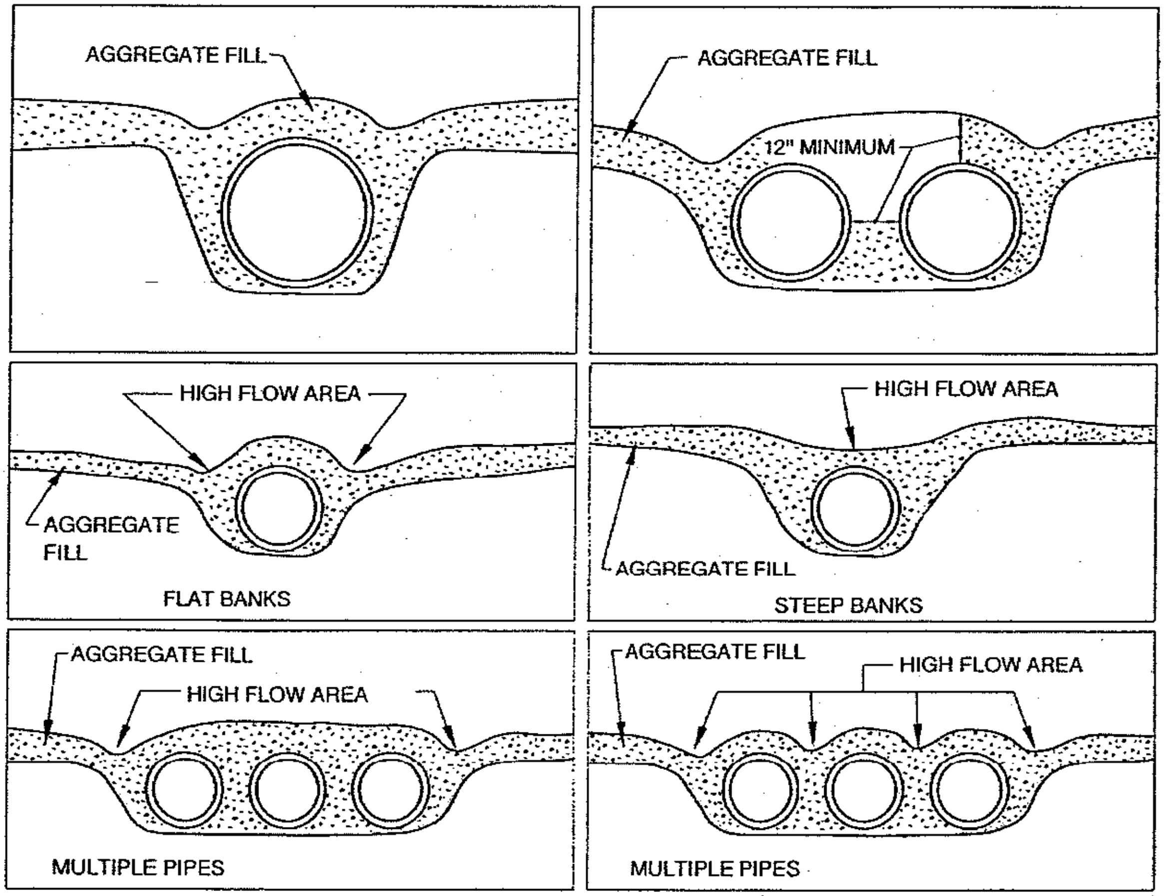
Note: Not to Scale

Maritimes & Northeast Pipeline L.L.C.			
2/10/99	Typical Fish Passage Way Intermediate Waterbody Crossing B	Figure 13	Dwn By: SJH March 1999

In compliance with the FERC regulations, the following device specifications for equipment crossings have been prepared. Figures 14, 15, and 16 illustrate the implementation of each type of equipment crossing. These methods are included as typical crossings although site-specific conditions will dictate which method will be used.

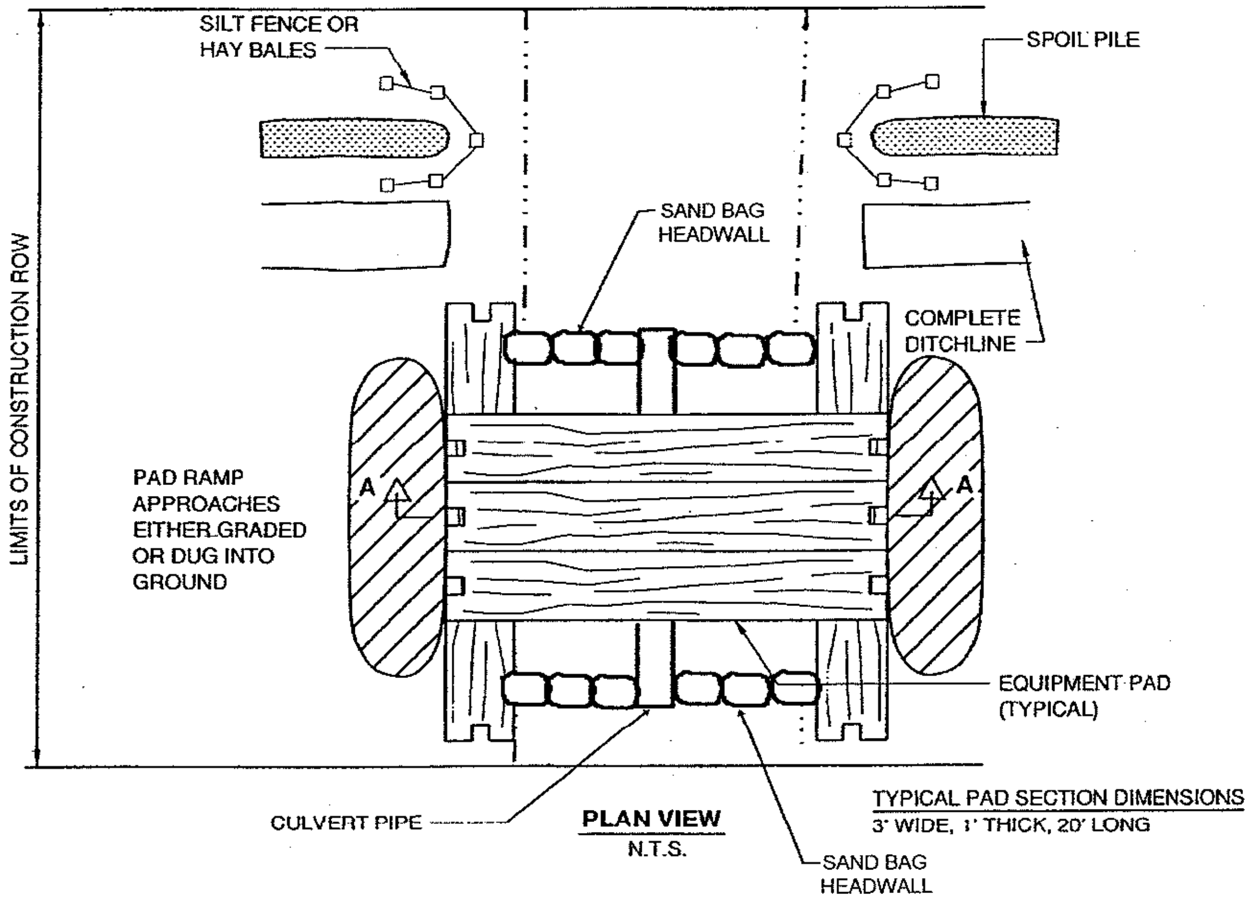
3.7 Additional Temporary Workspace

To facilitate pipeline construction across waterbodies, additional temporary workspace ("ATWS") may be needed adjacent to waterbodies to assemble and fabricate the length of pipe necessary to complete the crossing and to stockpile excavated ditch spoil. These work areas are in addition to the normal construction ROW. ATWS which is outside of the construction ROW must be located at least 100 feet from the edge of streams in wooded areas per the MEDEP requirements. All other areas (except actively cultivated or rotated cropland or other disturbed land) will be 50 feet from the edge of streams as required by the FERC, unless a variance is obtained from the FERC and MEDEP. In no event will vegetation be cleared outside of the construction ROW between the ATWS and the waterbody. The ATWS will be limited in size to the minimum area necessary to safely construct the waterbody crossing and accommodate any stockpile of excavated material from the trench and the prefabricated pipeline crossing section.

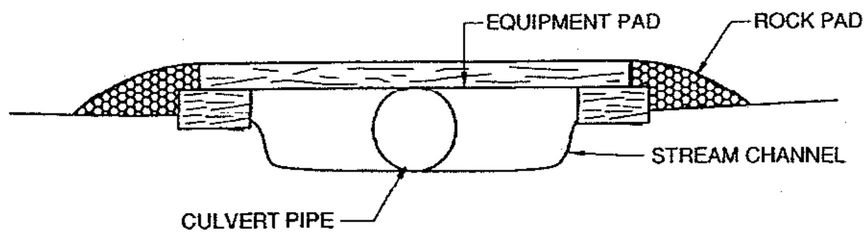


N.T.S.

Maritimes & Northeast Pipeline	Temporary Access Culvert	**Figure 14** Date: **March, 1999**



PLAN VIEW
N.T.S.

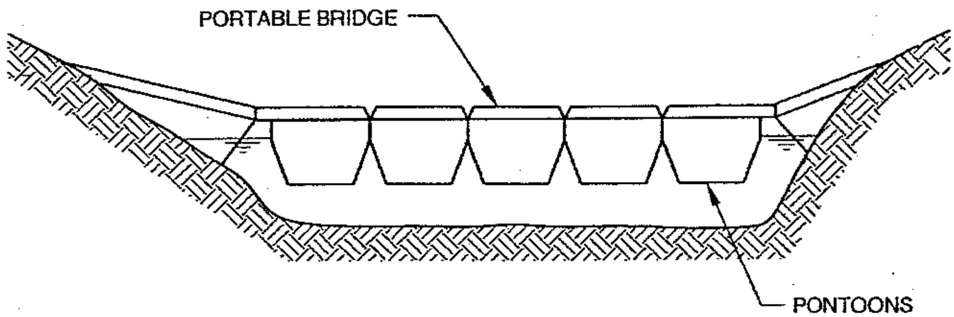


SECTION A-A
N.T.S.

NOTES:
1. CULVERT PIPE UTILIZED IF ADDITIONAL SUPPORT IS REQUIRED.
2. ADDITIONAL PADS CAN BE PUT SIDE BY SIDE IF EXTRA WIDTH IS REQUIRED.
3. EQUIPMENT PAD TYPICALLY CONSTRUCTED OF HARDWOOD; MUST ACCOMMODATE THE LARGEST EQUIPMENT USED.
4. ROCK PADS OR CRUSHED STONE SHALL BE USED AT ENTRANCE TO THE EQUIPMENT PADS (IF NECESSARY).

Maritimes & Northeast Pipeline	Temporary Equipment Crossing	Figure 15 Date: March, 1999

ev. 04678 4678-22



GENERAL NOTES:

1. STABILIZE EDGES WITH SANDBAGS OR STONE.
2. REMOVE DURING CLEANUP.

N.T.S.

Maritimes & Northeast Pipeline	Temporary Access Bridge	**Figure 16** Date: **March, 1999**

ev. 04678 4678-12

4.0 WETLAND CROSSING PROCEDURES

As used in these procedures the term wetland is defined by the Army Corps of Engineers ("ACOE") 1987 Wetland Delineation Manual (Technical Report Y-87-1) and the most recent performance standards and supplemental definitions required by the ACOE New England Division. Wetland crossing construction will adhere to the requirements of applicable wetland permits and Section 401 Water Quality Certification. In addition, no fill (gravel, sandbags, riprap etc.) will be placed within wetland areas to facilitate construction unless the appropriate permits are obtained.

4.1 Staging Areas

A staging area will generally be needed adjacent to wetlands to facilitate the pipeline crossing. The staging areas are in addition to the typical construction ROW and will be used for the assembly and fabrication of the pipe section that will cross the wetland area and to stockpile excavated trench spoil where necessary. This work area will be located at least 50 feet away from the wetland edge, topographic conditions permitting. If topographic conditions do not permit a 50-foot setback, these areas will be located at least 10 feet away from the wetland. Setbacks are also required adjacent to waterbodies (refer to Section 3.1). Where waterbodies are located within wetlands, the most restrictive setback will be followed, unless a site-specific variance is obtained from the MEDEP and the FERC. In no event will vegetation be cleared between the staging areas and the wetland. The work area will be limited in size to the minimum necessary to safely construct the wetland crossing. Locating the work area in this manner will minimize impacts to the wetland that are associated with pipeline construction. Impacts to water quality will be avoided while work is being performed in wetlands and other bodies of water by implementing the following measures:

- Construction materials, fuels, etc., will not be stored within wetlands or within 100 feet of any stream or wetland system, except under limited, highly controlled circumstances.

- Construction equipment will not be refueled within wetlands or within 100 feet of any stream or wetland system, except under limited, highly controlled circumstances and under direct supervision of the Environmental Inspector.

- Construction equipment will not be washed in any wetland or watercourse.

- Equipment will be well maintained and checked daily for leaks.

- Concrete coating will not be performed within 100 feet of any stream or wetland system, except at an existing site designated for such use.

4.2 Wetland Construction Procedures

Wetlands located along the pipeline route have been identified prior to construction. Construction in wetlands with standing water or saturated soils will be limited to the equipment necessary to clear the ROW, install the equipment crossings, dig the trench, install the pipe, backfill and restore the ROW. All other construction equipment will use approved access roads located in upland areas to the maximum extent practicable. Equipment pads and/or wide track construction equipment may be used in wetland areas, if necessary, to minimize damage to the soil structure. Rock fill, tree stumps or brush pads will not be used to support equipment in wetlands. Wetland areas that are dry at the time of construction may be crossed using normal cross-country construction techniques.

Where water levels are temporarily high due to recent storm events, the Chief Inspector and the Environmental Inspectors may direct that construction be postponed until water levels subside. Weather conditions will be monitored to avoid ditching and pipe placement during inclement weather conditions wherever possible.

In wetland areas, construction will be performed in a manner that minimizes disturbance to wetland vegetation. Brush and trees will be cut at ground level leaving the root systems intact. Tree stumps will only be removed directly over the trenchline and where necessary for safe access along the ROW. Ditch spoil will be temporarily piled in a ridge along the pipe trench with gaps maintained at appropriate intervals to allow for natural circulation or drainage of water. The top 1-foot of topsoil will be segregated from the trenchline except in areas where standing water ,saturated, or frozen soils are present. This soil will then be returned to its original position over the backfilled trench. If wetland excavation penetrates an impermeable soil layer responsible for maintaining a high water table, leakage will be prevented after pipe installation by sealing the excavation with impervious clay (bentonite) or reconstructing the layer with compacted native material. Precautions will also be taken to ensure that the trench does not act as an underground drainage channel. During construction, the movement of construction equipment in wetland areas will be minimized.

Construction in wetlands requires special considerations. Wetland soils generally lack stability, and special measures will be needed to support construction equipment. Equipment pads or timber riprap may be used as temporary equipment support. Only trees cut within the ROW may be used as timber riprap. There should be an attempt to use no more than two layers of timber riprap to stabilize the ROW. Timber riprap used as temporary equipment support will be removed from the wetland following construction.

As segments of the pipe are joined together at a non-wetland staging area, the pipe will be pushed, pulled or carried across the wetland where water and other site conditions allow. If the excavated trench is full of water, flotation devices may be fitted onto the pipe that is then floated into position. Once the pipe is in position across the wetland, the flotation devices will be removed from the trench and the pipe lowered into position. Movement of construction equipment in wetland areas will be kept to a minimum to reduce the disturbance to the wetland. If conditions allow, normal cross-country pipeline construction methods will be used in wetland areas.

4.3 Erosion and Sedimentation Control

Erosion and sediment control devices will be installed along the perimeter of wetlands prior to soil disturbance activities as depicted on the project plans or as deemed necessary by the Chief and/or Environmental Inspectors to protect the resource areas. Erosion control devices will also be installed across the ROW along the limits of disturbance at the wetland boundary prior to the onset of soil disturbing activities to ensure that spoil piles and other disturbed soil areas are confined to avoid sediment flow into wetland areas. Timber and brush will be cleared within the ROW, with stumps cut at ground level and left in place where possible. In areas of active construction, erosion controls will be inspected on a daily basis by the Environmental Inspector and maintained or replaced as necessary.

Trench dewatering may become necessary during wetland crossing operations. Trench water will be pumped into a filter bag and/or sediment trap constructed of hay bales or silt fence so that no heavily silt-laden water flows into any wetland. The pump intake hose will not be allowed to be set on the trench bottom throughout dewatering. Care will be taken to insure that natural drainage is not adversely affected. The basin and all accumulated sediment will be removed following dewatering operations, and the area seeded and mulched.

During clean up, permanent slope breakers will be installed across the ROW at the base of all slopes adjacent to wetlands, as necessary. Slope breakers may extend slightly beyond the edge of the construction ROW to effectively drain water off the disturbed area. These areas are subject to compliance with all applicable T&E and cultural resources survey requirements. These devices will divert surface runoff away from the disturbed construction corridor and minimize the potential for downslope sedimentation. Slope breakers must be spaced so that they will outlet to a vegetated area. However, if no vegetation is present within a reasonable distance of where a slope breaker must be located to properly function, then the outlet must be stabilized by installing an energy dissipating device typically constructed with haybales and/or silt fence, at the outlet. These diversion berms will be left in place following construction to avoid channelization of waters on the ROW during revegetation.

Hay bales, silt fence, and/or earthen berms will also be installed across the ROW at the base of all slopes located adjacent to wetlands as required by FERC or other applicable agency until ROW revegetation is complete. The construction area will be monitored to ensure that erosion control measures are functioning properly both during and following construction.

4.4 Restoration

Wetland restoration procedures that have been previously approved for the Phase II Project and are also proposed for the Phase IV Project are included in Appendix G. These procedures are based on the FERC *Procedures* and requirements of the Army Corps of Engineers.

5.0 EROSION CONTROL, REVEGETATION AND MAINTENANCE PLAN

The following erosion control plan has been prepared to mitigate project-related impacts to the environment associated with pipeline construction. Site specific information will be assimilated by the Environmental Inspector to develop an efficient plan to minimize erosion and control sedimentation. Maritimes & Northeast's erosion and sediment control plan illustrates standard measures that will be used to minimize the risk of sediment pollution, and implementation and maintenance of these devices.

Sediment barriers shall be located between all disturbed areas and wetlands, waterbodies, and other protected resources, unless the land slopes away from the resource. In the case of wetlands and waterbodies, sediment barriers must be located across the ROW and/or along the edge of the ROW at the interface between the wetland or waterbody. Temporary sediment barriers shall be replaced each day after an area is disturbed. In erosion sensitive areas such as grades of 5 percent or more, or along streambanks, appropriate measures (e.g. installation of hay bales, silt fence, excelsior logs and/or slope breakers) will be taken to minimize erosion. The following is a brief description of the various methods that may be employed to effectively control erosion:

- Structural Measures – These measures include temporary and permanent erosion control devices employed during and following construction. These include design and grading techniques that will be used to control runoff and erosion.

- Restoration and Vegetative Measures – Erosion will be minimized by protecting the soil surface from rainfall impact and overland flow of runoff. The best method of protecting the soil surface is through vegetation. In the absence of vegetation, stabilization through mulching will be provided.

5.1 Structural Measures

Structural erosion and sediment control practices are classified as either temporary or permanent. Temporary structural practices will be used during construction to prevent off site sedimentation. Permanent measures will be used to control surface water runoff to a stable area and will remain in place and continue to function following the completion of construction. Implementation of the appropriate structure, as shown on the project plans or determined by the Environmental Inspector, will minimize project-related erosion and sedimentation.

Effort will be made to minimize the width of the ROW to limit the amount of disturbed area during construction activities. Earthen structures such as diversion berms, dikes, and swales may be constructed to control off site sedimentation. In erosion sensitive areas such as grades of greater than 5 percent, or along stream banks, jute netting, mulch, and/or equivalent measures will be taken to control erosion (See Figures 17 through 25 located at the end of this Section). Measures selected and implemented must be properly maintained in order to remain functional.

5.2 Vegetative Stabilization and Restoration Measures

Proper vegetative stabilization is dependent on the selection of the appropriate seed for upland and wetland areas. Seed mixtures are generally composed of perennial and annual species. Perennials do not produce much top growth or seed the first year. Perennials develop a strong sturdy root structure that generally inhibits the growth of native vegetation. Annuals however, reproduce only from seed rather than roots, therefore they produce good top growth and seed the same year planted. Annual species are more suitable as a temporary vegetative measure and generally allow native vegetation to recolonize the disturbed area.

Depending on the area in which the seed is planted and whether temporary or permanent vegetation is desired will determine the best seed mix suitable for that area. Upland areas will be generally planted with a mix of perennial species during the growing season to establish permanent vegetative stabilization. Upland areas are generally suitable for supporting the growth of perennial species with strong rootstock since revegetation for permanent stabilization is the primary concern.

Restoration efforts including final grading and installation of permanent erosion control devices will be completed in accordance with the following FERC and MEDEP guidelines, weather and soil conditions permitting.

- No more than 45 days shall pass between the completion of welding (pipe gang) and final restoration. Cleanup will be started immediately after backfilling the trench is completed. Except where more stringent requirements apply, final grading, topsoil replacement and the installation of permanent erosion control structures will be completed within 20 days after backfilling the trench (10 days in residential areas). If seasonal or other weather conditions prevent compliance with these timeframes, maintain temporary erosion controls (temporary slope breakers and sediment barriers) until conditions allow completion of cleanup.

- All stream banks and an additional 100 feet on each side of the stream must be permanently stabilized within the timeframes for stream stabilization as defined in Section 3.2.

- If permanent stabilization has not been established on the ROW, temporary mulching must take place within 100 feet of any edge of all waterbodies and wetlands at any time when there is no activity in the ROW for more than a 7-day period or prior to a storm event when erosion is likely to occur (for example, if more than 7 days elapse between final grading and permanent stabilization). Wetland areas located within 100 feet of waterbodies will be protected with straw mulch.

- If permanent stabilization has not been established on the ROW, temporary mulching must take place outside of areas within 100 feet of the edge of all waterbodies and wetlands at any time when there is no activity in the ROW for more than a 20-day period (10 days in residential areas), and within 10 days of final grading.

- Dormant seeding may be done between the first killing frost and the first permanent snowfall (seed may not be placed on snow).

- All work areas exposed after November 30 (excluding the travel lane of the ROW) must be mulched on a daily basis each time soil disturbance occurs.

Permanent Vegetative Measures

The tables below provide a concise summary of seeding and mulching requirements for the project. In developing the seeding and mulching requirements for the Phase II Project, the State of Maine Best Management Practices were reviewed to ensure successful vegetation establishment and effective temporary and permanent erosion and sediment control during construction and after project completion. Based on the success observed during the monitoring of the restoration and revegetation of the Phase II Project, the same seed mixtures are proposed for use on the Maritimes Phase IV Project. The permanent ROW seed mixture will be applied to most upland areas of the ROW, unless a site specific restoration mix is required or if landowners request an alternate seed mixture.

During the project, seeding with the permanent ROW seed mix will be allowed until October 1. After October 1, 120 pounds per acre of winter rye will be added to the permanent seed mix. Depending on weather conditions, supplemental winter rye may be added as early as September 15 (if freezing weather occurs early in the year). The supplemented seeding mixture will be applied to the ROW, weather permitting, until snow accumulation on the ROW restricts the seeding operations. No seeding will take place if snow cover exceeds 1 inch. In addition to winter rye, temporary winter straw mulch will be applied at a rate of 2 tons per acre to assist with winter stabilization of the ROW. The permanent seed mixture will be included in late season seed and mulching efforts. This approach allows for the potential successful catch of the permanent perennial seed mixture, thereby reducing the magnitude of access efforts (installation of equipment crossings at streams, etc.) required the following spring.

The ROW will be evaluated in the spring following the completion of construction. Areas where vegetation has not successfully established will be re-seeded and mulched as soon as soil and ROW conditions allow access.

TABLE 5. SEED MIX SPECIFICATIONS

Seed Mix Name	Seed Mix Components	lb./acre [1]
Permanent ROW Mix	Redtop	4
	Creeping red Fescue	40
	Tall Fescue	40
	Birdsfoot trefoil	16
Wild Turkey Federation Mix, Strut N' Rut	Alfalfa	8
	Annual Rye	8
	Red Clover	8
	Birdsfoot Trefoil	8
	White Dutch Clover	8
Wood Chip Application Seed Mix	Creeping Red Fescue	20
	Redtop	4
	Tall Fescue	30
	Crownvetch	30
Annual Rye	Annual ryegrass	40
Winter rye [2]	Winter ryegrass	120

Notes:
1. Increase seeding rates 10% when hydroseeding
2. Winter rye will be added to Permanent ROW mix at a rate of 120 lb./acre after October 1.

TABLE 6. SUMMARY OF PERMANENT SEEDING REQUIREMENTS		
	Permanent Seeding	
Condition	**Timing[1,2]**	**Seed Mix**
Upland portions of the ROW	ROW will be seeded within 6 days of final grading	Permanent ROW mix
Slopes >3:1	ROW will be seeded immediately after seedbed preparation	Permanent ROW mix
Streambanks	ROW will be seeded immediately after restoration of stream banks	Permanent ROW mix & Annual Rye
100 feet from streambanks (no wetlands present)	ROW will be seeded immediately after restoration of stream banks	Permanent ROW mix & Annual Rye
100 feet from streambanks (wetlands present)	ROW will be seeded immediately after restoration of stream banks	Annual Rye
Wetlands	ROW will be seeded within 6 days of final grading	Annual Rye
Wood chip application areas	ROW will be seeded within 6 days of final grading	Wood chip application seed mix
Deer Wintering Areas	ROW will be seeded within 6 days of final grading	Wild Turkey Federation Mix, Strut n' Rut

Notes:

1. Weather conditions permitting
2. In the late fall, seeding windows noted in this plan may exceed the optimal seeding windows. However, given the difficult access conditions along the pipeline ROW once streams and wetlands have been restored and equipment crossings have been removed, as well as the availability of equipment and manpower during fall restoration of the ROW, continuation of seeding applications under less than optimal conditions will increase the likelihood of ROW stabilization and revegetation during the winter and following spring. Areas that do not successfully revegetate within the appropriate period of time will be reseeded as necessary.

Deer Wintering Areas

The Wild Turkey Federation "Strut-n-Rut" seed mix specifically designed for the northeast region will be applied to all designated Deer Wintering Areas ("DWA") disturbed along the ROW. Upland areas within the construction ROW need to be seeded specifically with this seed mix. The application rate recommended by the Wild Turkey Federation is 10 to 20 pounds per acre, however will be applied at 40 pounds per acre to insure vegetative stabilization. Wetlands within these DWAs must be seeded with annual rye as described below.

Wetlands

Wetlands will be stabilized and surface contours reestablished to their original grade following construction. Wetland restoration procedures (Refer to Appendix G) will include measures to address the invasion of undesirable exotic species where necessary. Annual rye grass will be seeded in the impacted wetland area at 40 pounds per acre unless standing water is present. Temporary sediment control barriers will be removed where they have been installed as needed along the sides of the ROW in wetland areas during clean-up in accordance with the FERC Procedures. Temporary sediment control measures across the ROW will be removed when replaced with permanent erosion control measures when the ROW has become stabilized with vegetation. Wetlands located within 100 feet of waterbodies will be stabilized with straw mulch. All other wetlands do not need to be mulched.

Fertilizer and Limestone Requirements

In general, fertilizer and lime application rates will follow the guidelines identified below unless site specific soil tests identify the need for alternative fertilizer/lime application rates. Fertilizer will be applied to most upland areas of the ROW prior to seeding at a rate of 800 pounds per acre using 10-20-20 (N-P205-K20) or equivalent. Ground limestone (equivalent to 50 percent calcium plus magnesium oxide) will be applied to the ROW at a rate of 3 tons per acre. An equivalent mixture of fertilizer and lime may be applied using the hydroseeding method. No lime or fertilizer will be applied to any stream banks, waterways, or wetlands.

Hydroseeding

Hydraulic application (hydroseeding) is an alternative method of revegetation, and is a suitable method for use. Hydroseeding combines the seed, fertilizer and lime, and may include paper mulch, wood fiber or straw, mixed with water that is sown in one application. Hydroseeding is generally limited to upland areas on slopes less than 2:1 (2 feet horizontal to 1 foot vertical). This type of seeding application is recommended for use during the growing season, weather, accessibility, local restriction, and conditions permitting. Seeding rates will typically increase 10 percent when hydroseeding. Hydroseeding with mulch and annual rye seed only will be allowed in wetland areas.

Paper mulch and wood fiber mulch are normally used in hydroseeding applications. Paper mulch is generally comprised of recycled newspaper and wood fiber mulch is generally comprised of thin strands of wood fiber. Wood fiber mulch is more durable and more resistant to decomposition than paper mulch. Paper mulch typically decomposes within 30 days following application leaving the soil surface without adequate protection against erosion. If hydroseeding methods are used for revegetation purposes, paper mulch will only be allowed for use during the growing season and will be spread at a minimum rate of 1,500 pounds per acre. If paper mulch is used on slopes greater than 30 percent, or vegetation has not become well established prior to the onset of winter, additional hay mulch will be spread as a winterizing measure on all surfaces treated with paper mulch to insulate and stabilize the exposed soil. If wood fiber mulch is used, it will be spread at a minimum rate of 1,500 pounds per acre during the growing season. If it is anticipated that vegetation will not become established prior to the onset of winter, wood fiber mulch can be used as a winterizing measure and will be applied at a rate of 2,000 pounds per acre and will not require additional hay mulch. The Chief and Environmental Inspectors will determine the most appropriate method of revegetation to be used based on existing conditions at the time of application.

Mulching Specifications

If permanent stabilization has not been established on the ROW, temporary mulching must take place within 100 feet of the edge of all waterbodies and wetlands at any time when there is no activity in the ROW for more than a 7 day period (for example, if more than 7 days elapse between final grading and permanent stabilization) or prior to a storm event when erosion is likely to occur. For areas located more than 100 feet of the edge of waterbodies and wetlands, temporary mulching will occur within 20 days after backfilling the trench (10 days for residential areas) if final grading and installation of permanent erosion control measures have not been completed.

Determination of a storm event should be based on visual inspection of the weather and on reports by the National Weather Service for the relevant geographical area. Estimation of the likelihood of erosion during a storm event should be based on the anticipated volume of precipitation and estimated length of time that the precipitation will fall as predicted by the National Weather Service's advisory reports.

The selection of mulching materials will be based on the season, soil and site conditions. Winter mulching must commence beginning November 1. Mulching measures will be employed on all disturbed areas and as needed in wetlands. Mulch materials will be spread uniformly by hand or machine. Application rates, conditions, mulch type, and timing for both temporary and permanent mulch requirements are summarized in the Table 7.

Mulch Anchoring

All straw mulch will be firmly anchored into the soil utilizing one of the following methods

- Crimping with a straight or notched mulch crimping tool (farm discs will not be allowed);
- Track walking with deep cleated equipment operating up and down the slope (mulch crimped perpendicular to the slope) on slopes <25 percent;
- Application of 500 lb./acre of wood fiber mulch over straw/hay mulch; and
- Commercially available tackifiers (except within 100 feet of waterbodies or wetlands).

Tree Protection

Existing trees that are located off the ROW will be protected from mechanical injury during construction. Care will be taken to avoid damaging limbs and feeder roots during construction. Trees that pose a hazard to safety will be removed.

During final clean up, damaged trunks will be trimmed and tapered and damaged limbs will be cut off above the collar at the preceding branch juncture (see Figure 26). The branch collar on all branches will not be damaged. The three cut method will be used on all branches larger than 2 inches at the cut. The first cut will be located approximately 8 inches from the trunk about 1/3 the way through the underside of the limb. The second cut will be located approximately 1 inch further out on the branch on the top of the limb. This will prevent the bark from peeling down the trunk. The final cut to remove the nub will be made above the collar where the limb attaches to the trunk.

5.3 ROW Maintenance

All ROW maintenance activities for certificated projects will comply with FERC requirements regulating such activities, except as specifically provided in this section. These maintenance provisions restrict the amount of vegetation maintenance that can occur on new pipeline facilities. Where the newly established pipeline ROW is located on other existing ROWs not affiliated with Maritimes & Northeast, the easement holder or owner will continue to maintain their ROWs using procedures specified in their vegetative management programs.

TABLE 7. SUMMARY OF TEMPORARY AND PERMANENT MULCH APPLICATION REQUIREMENTS

Condition	Timing	Mulch Type[1,2]	Application Rates[3]
Temporary			
Within 100 feet of waterbodies and wetlands	If no activity in the ROW for 7 days, or prior to a storm event	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
All areas of the ROW	If no activity occurs on the ROW for 30 days.	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
All areas of the ROW	Mulch before seeding if final grading and installation of permanent erosion control measures will not be completed in an area within 20 days after the trench is backfilled (10 days in residential areas).	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
Stockpiles within 25 feet of waterbodies	If stockpiles are in place longer than 48 hours, they must be mulched within 7 days or prior to a storm	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
All disturbed areas of the ROW	After November 1	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
All work areas exposed (except the travel lane) are to be mulched daily each time soil is disturbed	After November 30	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lb./acre
Permanent			
Within 100 feet of waterbodies	Site specific timing required within 100 feet of waterbodies (Restoration Zone) as described in Section 3.2 – Table4	Straw mulch or Wood fiber mulch	2 tons/acre 2000 lbs./acre
On all slopes where needed to stabilize the soil surface (except in actively cultivated cropland)	Cleanup, including mulching, must be completed within 20 days of backfilling the trench (10 days in residential area) (except where more stringent requirement apply)	Crimped straw mulch or Paper mulch or Wood fiber mulch	2 tons/acre 1500 lbs./acre[4] 2000 lbs./acre
Wood chip application areas	Cleanup, including mulching, must be completed within 20 days of backfilling the trench (10 days in residential area) (except where more stringent requirement apply)	Crimped straw mulch or Paper mulch or Wood fiber mulch	2 tons / acre 1500 lbs./acre[4] 2000 lbs./acre

Notes:
1. Straw and hay mulch may be used interchangeably, except in wetland areas within 100 feet of streams where straw mulch will be required.
2. Double rate of wood fiber mulch when used in critical areas.
3. Straw, hay, or hydromulch (wood fiber or paper mulch as appropriate) will provide 90 percent ground coverage
4. Paper mulch is acceptable for use during the growing season. On slopes >30 percent and in areas where vegetation has not established well, additional hay mulch will be added as a winterizing measure.

Upland Areas

Routine maintenance of the permanent ROW is required to allow continued access for routine pipeline patrols, maintaining access in the event of emergency repairs, and visibility during aerial patrols. In upland areas, maintenance of the ROW will involve clearing the entire ROW of woody vegetation. Routine ROW vegetation maintenance clearing shall not be done more frequently than every 3 years. However, to facilitate periodic corrosion surveys, a corridor centered on the pipeline up to 10 feet wide may be maintained annually in a herbaceous state. In neither case shall maintenance clearing occur between April 15 and August 1 of any year. Maritimes & Northeast does not plan to apply herbicides for ROW maintenance.

Maritimes & Northeast use herbicides in limited instances for weed control at above-ground facilities. There are certain locations at above-ground facilities where the use of mowing or other mechanical means is not practical or effective for controlling weeds and other vegetation. These locations are typically small areas at compressor and meter stations and valve sites where revegetation was not intended and where a gravel or crushed stone surface was put in place during construction, which makes mowing impracticable. In addition, many of these areas are fenced and/or have various other structures, pipes, test leads or electrical equipment protruding from the ground which also makes mowing impracticable.

Wetland Areas

Following construction, the entire ROW within wetlands will be allowed to revegetate with native woody plant species, with the exception of two 10-foot wide strips, one centered on the Phase II Mainline and the other centered on the proposed Phase IV Pipeline. These 10-foot wide strips may be maintained in an herbaceous state to facilitate pipeline operations and maintenance activities. Given the 25-foot separation between the Phase II Mainline and the Phase IV Pipeline, there will be a 15-foot wide corridor between the two pipes that will be allowed to revegetate with woody plant species. Trees and shrubs greater than 15 feet in height that are located within 15 feet of the Phase II Mainline and Phase IV Pipeline may be selectively cut. This wetland maintenance configuration will also be used in the 100-foot riparian zones established at waterbody crossings. Figure 27 illustrates vegetation maintenance practices as applied to the typical Phase IV looped right-of-way.

The maintenance procedures for wetlands must also be applied to any Deer Wintering Area locations.

Waterbodies

Vegetation maintenance practices on the construction ROW adjacent to waterbodies will consist of maintaining a riparian strip that measures 25 feet back from the mean high water mark. This riparian area will be allowed to permanently revegetate with native woody plant species across the entire ROW. The wetland maintenance configuration will also be used in riparian zones established at waterbody crossings. Figure 28 illustrates vegetation maintenance practices within wetlands and riparian corridors within the construction ROW.

Maritimes & Northeast has agreed to extend the maintenance setback from 25 feet to 100 feet at all perennial Class A, AA, coldwater and coldwater/warmwater waterbodies represented on the waterbody table in Appendix E, unless the MEDEP approves a variance based on site-specific conditions.

Deer Wintering Areas

Maintenance within Deer Wintering Areas will follow the maintenance procedures required for wetland areas, as provided in the Wetland Area section below. In general, vegetation maintenance practices over the full width of the construction ROW is prohibited. However, to facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline up to 10 feet wide may be maintained annually in a herbaceous state. In addition, trees that are located within 15 feet on either side of the pipeline and are greater than 15 feet in height may be selectively cut and removed from the ROW. Trees and shrubs beyond 15 feet on either side of the pipeline will not be maintained. Figure 27 illustrates vegetation maintenance practices as applied to the typical Phase IV looped right-of-way.

5.4 Monitoring

Follow-up inspections in upland and agricultural crop lands shall occur after the first and second growing season, normally 3 to 9 months and 15 to 21 months after planting, respectively, to determine the success of revegetation For non-agricultural upland areas, revegetation shall be considered successful if the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands, based on representative random sampling in the field (e.g., visual survey). In agricultural areas, revegetation shall be considered successful if crop yields are similar to adjacent undisturbed portions of the same field. If vegetative cover is considered unsuccessful or if there is a need for noxious weed control measures (refer to Appendix G), the judgment of a professional agronomist shall be used to determine the need for additional restoration measures (such as fertilizing or reseeding) based on site conditions. Appropriate actions shall be undertaken as recommended by the agronomist.

Following the completion of construction, periodic monitoring by the Environmental Inspector will occur following major storm events and generally once a month, to determine if protection measures are functioning as anticipated. Inspections will continue until the Environmental Inspector is satisfied that the ROW is effectively stabilized and permanent erosion controls are functioning properly. Wetlands will be monitored annually for the first 3 years to determine the success of revegetation. Any area not supporting indigenous vegetation similar to the density of adjacent undisturbed areas will be evaluated to determine the need for reseeding based on site conditions. In addition, all erosion and sedimentation control devices installed during and following construction to stabilize disturbed areas will be inspected during routine patrols to ensure proper functioning. Any deficiencies found will be reported and corrected as needed. Once the area has revegetated and stabilized, the erosion controls will be removed. Revegetation will be considered successful when the native herbaceous and/or woody cover is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas not disturbed by construction. At the end of 3 years after construction, Maritimes & Northeast shall file a report with the Secretary documenting the status of the wetland revegetation efforts, including percent cover and problem areas. If problem areas are encountered (weed invasion issues, poor revegetation, etc.), the report shall include (after consultation with a professional wetland ecologist) a plan to actively revegetate the wetland with native wetland herbaceous and woody plant species. Efforts to control off-road vehicle use including pipe gates, signs, and fencing, in cooperation with the landowner, will continue following construction.

The following are specifications for erosion and sedimentation control devices to be implemented by Maritimes & Northeast as applicable to control construction related sedimentation.

Device: Erosion-control fabric/Jute netting

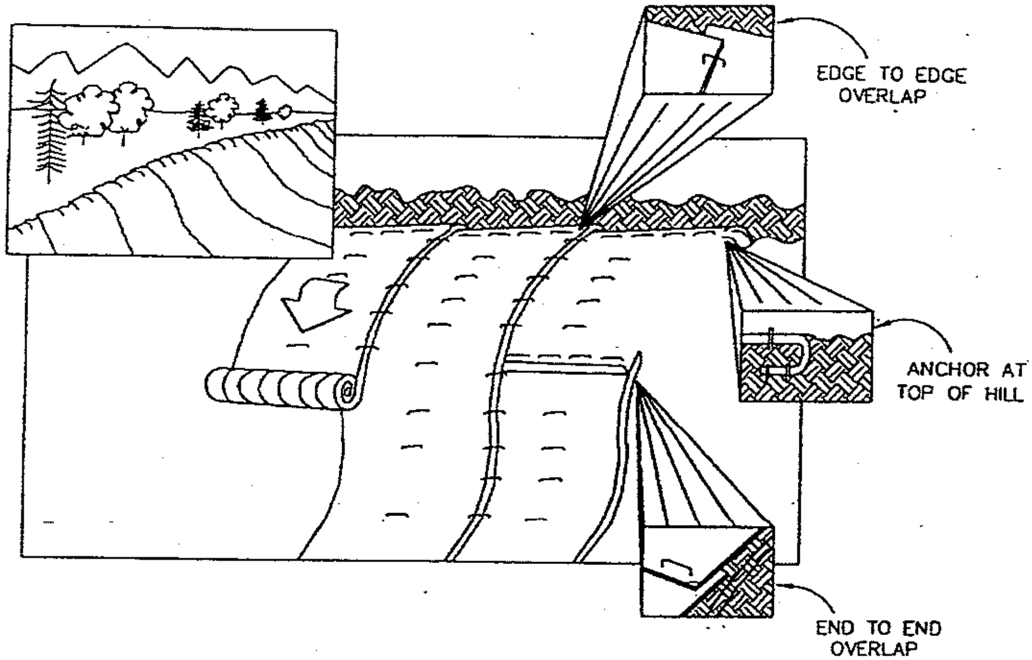
Application: Drainage swale lining
Streambank stabilization
Steep slope stabilization

Description: Erosion control fabric or matting is a loosely woven burlap type material or other biodegradable plant fiber material. These materials will be placed over mulch, on all slope conditions. In these applications water and air is admitted to promote seed germination and growth.

Installation: Erosion control fabric will be installed on stream banks and drainage swales following final seeding, as needed, to prevent erosion prior to revegetation. In addition, erosion control fabric may be installed on slopes greater than 3:1, in lieu of anchored mulch where potential erosive soils are identified. Jute netting will be applied over mulch.

Maintenance: Channels and slopes lined by fabric will be properly anchored. Check anchoring and inspect the fabric for tears. Damaged fabric will be replaced where necessary and the channel cleared of debris and obstructions. Inlet and outlet areas should be checked for scour and repaired.

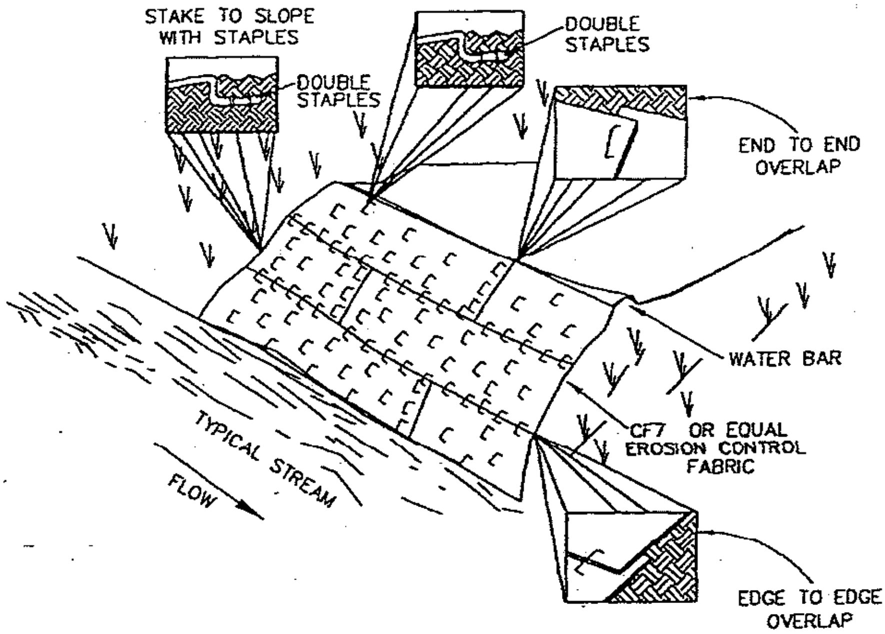
Specification: The disturbed area shall be free of brush, stumps and other debris that could damage the fabric. Unroll fabric downslope to level area or in direction of water flow. Secure at top by trenching in 6 inches and reinforce with staples. Place staples about 18 inches apart and flush with soil surface. Provide a 4-6 inch overlap on all edges and over the start of the next roll. Securely staple the two layers to the ground (see Figures 17, 18, 19, and 20). In areas of unconsolidated soils or saturated soils, use wooden stakes installed at opposing angles.



NOTES:

1. Erosion control matting (blnaket(s) shall be used at locations identified in the Soil Erosion and Sedimentation Control Guidelines and/or as directed by the Environmental Inspector.
2. The erosion control matting shall meet the requirements specified in the Soil Erosion and Sedimentation Control Guidelines and/or as directed by the Environmental Inspector.
3. Staples shall be made of 11 gauge wire, U-shaped with 6" legs and a 1" crown. Staples shall be driven into the ground for the full length of the staple legs.
4. Matting shall be installed according to manufacturer specifications or as stated below:
   - The top of the blanket shall extend 3' past the upper edge of the slope.
   - Anchor ("key") the upper edge of the blanket into the slope in a 6" wide by 6" deep trench. The blanket roll shall be on the uphill side of the trench. Double staple every 12" before backfilling and compacting trench.
   - Avoid stretching erosion control matting (loosely) during installation.
   - Bring mat roll back over the top of the trench and continue to roll down slope. Staple every 12" where mat exits the trenchat the top of slope.
   - When blankets are spliced down slope to adjoining mats (slope or stream bank mats), the upper blanket shall placed over the lower mat (shingle style) with approximately 6" of overlap. Staple through the overlapped area every 12".
   - Overlap adjacent blankets 6". Staple edges of blankets and center every 36".
5. In livestock areas where erosion control matting is applied to streambanks, fencing will be used if necessary to exclude livestock, with permission of the landowner.
6. Monitor for washouts, staple integrity or mat movement. Replace or repair as necessary.

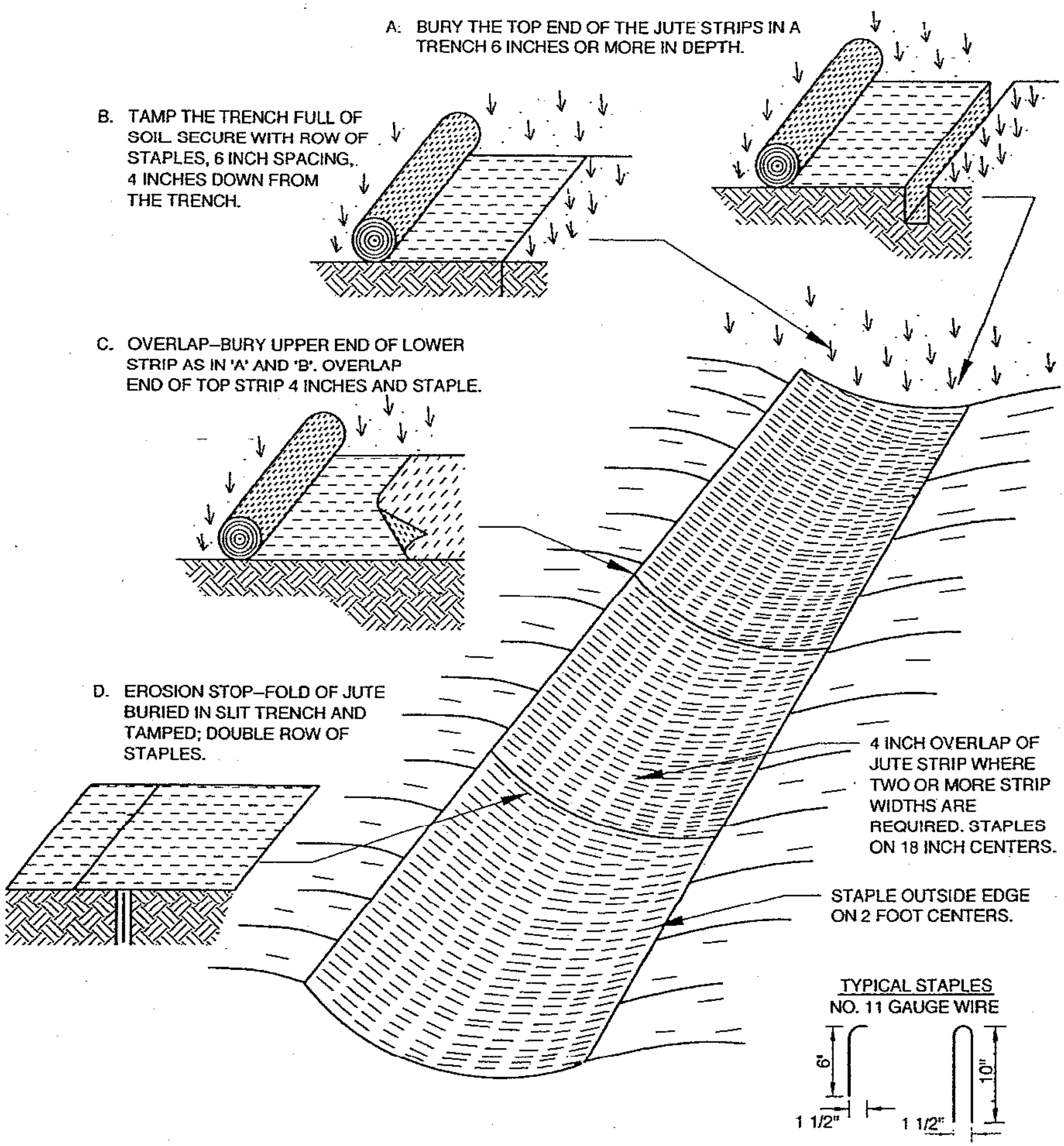
Maritimes & Northeast Pipeline	Typical Matting Slopes	Figure 17 Date: March, 1999



NOTES:

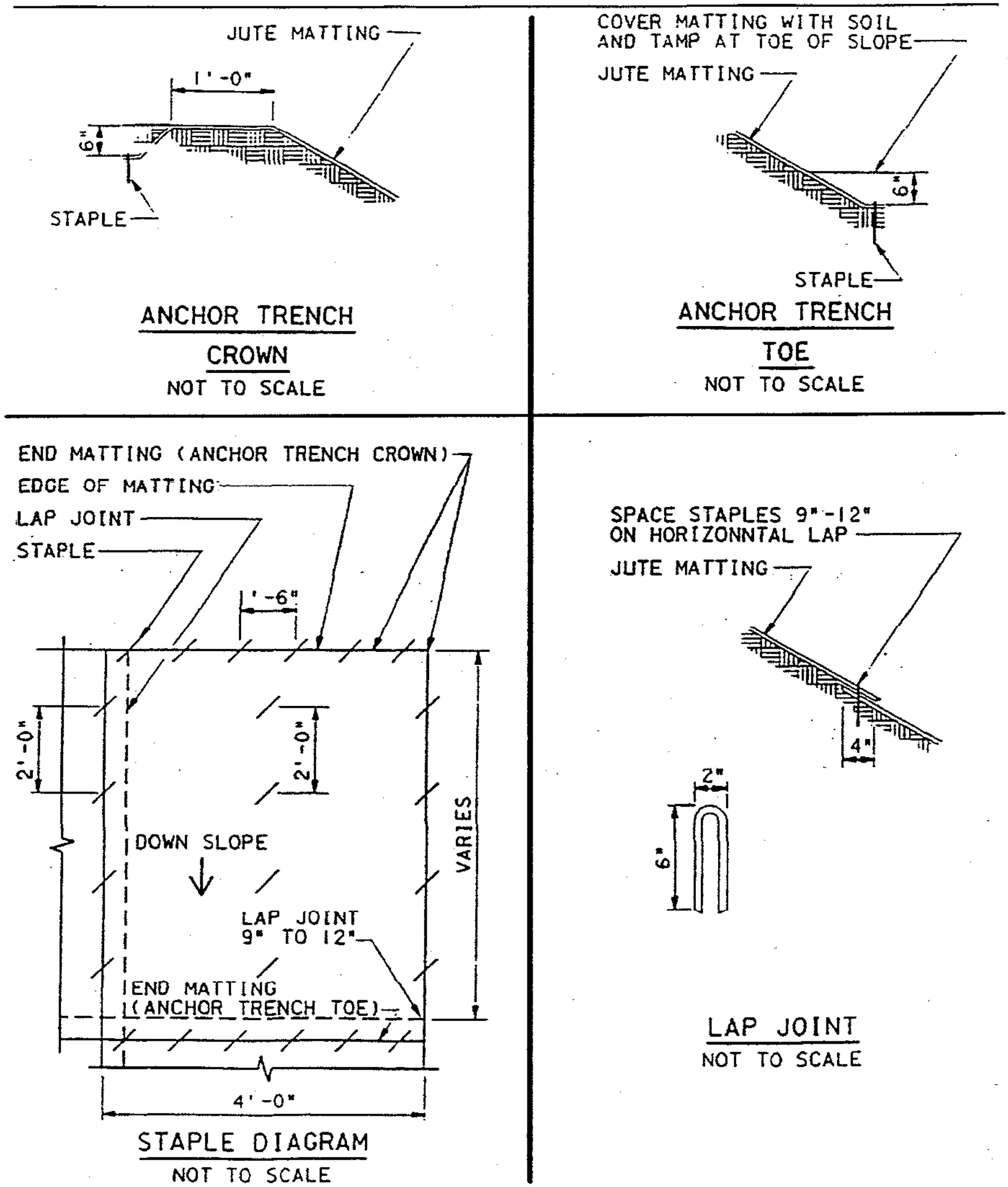
1. Erosion control matting shall be placed on the banks of flowing streams where vegetation has been removed or as directed by the Environmental Inspector.
2. The erosion control matting shall meet the requirements specified in the Soil Erosion and Sedimentation Control Guidelines and/or as directed by the Environmental Inspector.
3. Staples shall be made of 11 gauge wire, U-shaped with 6" legs and a 1" crown. Staples shall be driven into the ground for the full length of the staple legs. Alternately 1" wooden pegs 6" long and beveled to secure matting.
4. Matting shall be installed according to manufacturer specifications or as stated below:
   - The top of the blanket shall extend 2' past the upper edge of the high water mark. If a waterbar is present on the approach slope, the blanket shall begin on the uphill side of the waterbar.
   - Install blanket(s) across the slope in the direction of water flow.
   - Anchor ("key") the upstream edge of the blanket(s) into the slope using a 6" wide by 6" deep trench. Double staple every 12" before backfilling and compacting trench.
   - Anchor ("key") the upper edge of the blanket into the slope using a 6" wide by 6" deep trench. Double staple every 12" before backfilling and compacting trench.
   - The edges of parallel blankets shall be overlapped a minimum of 6". The upper blanket shall be placed over the lower blanket (shingle style) and stapled every 12" along the length of the edge.
   - When blanket ends are to adjoining blankets, the upstream blanket shall be placed over the downstream blanket (shingle style) with approximately 6" of overlap, staple through the overlap area every 12".
   - Staple down the center of the blanket(s), three staples in every square yard.
5. In livestock areas where erosion control matting is applied to streambanks, fencing will be used if necessary to exclude livestock, with permission of the landowner.
6. Monitor for washouts, staple integrity or mat movement. Replace or repair as necessary.

Maritimes & Northeast Pipeline	Typical Matting Streambanks	Figure 18 Date: March, 1999



Maritimes & Northeast Pipeline	Erosion Control Fabric Installation	**Figure 19** Date: **March, 1999**

ev. 04678 4678-10



Maritimes & Northeast Pipeline	**Jute Matting Anchoring Procedures**	**Figure 20** Date: **March, 1999**

Device: Straw/Hay Bales

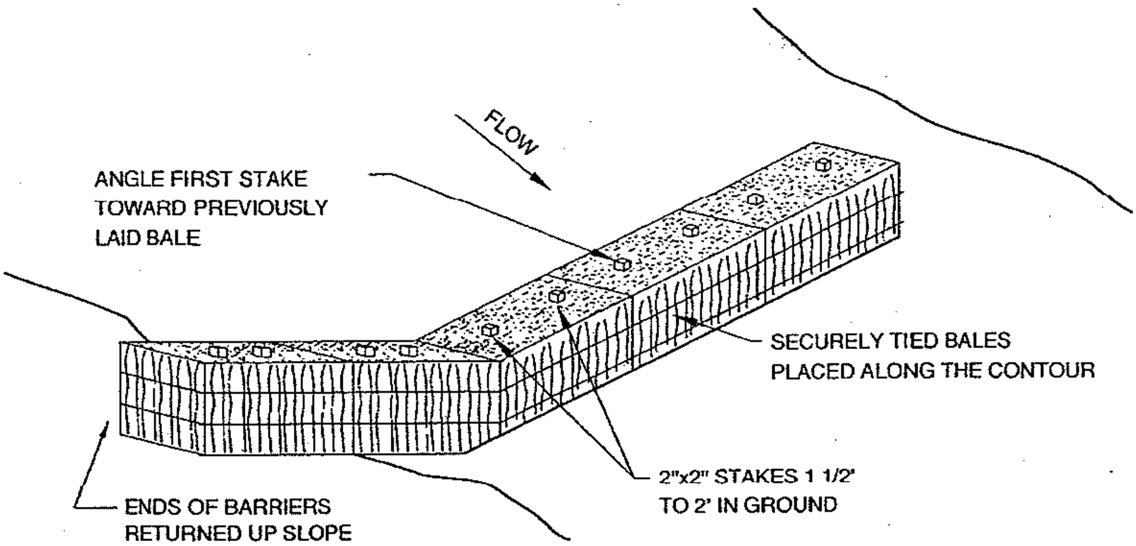
Application: Temporary sediment filter device
Stormwater drain inlet protection
Temporary slope breaker
Drainage swale check dam
Settling basin filter device
Diversion outlet protection
Streambank stabilization

Description: A temporary barrier of straw or similar material used to intercept sediment laden runoff from small drainage areas exhibiting disturbed soil conditions. Sedimentation control is accomplished by reducing runoff velocity and trapping transported sediment. Hay bales also provide a visual and physical barrier defining project limits.

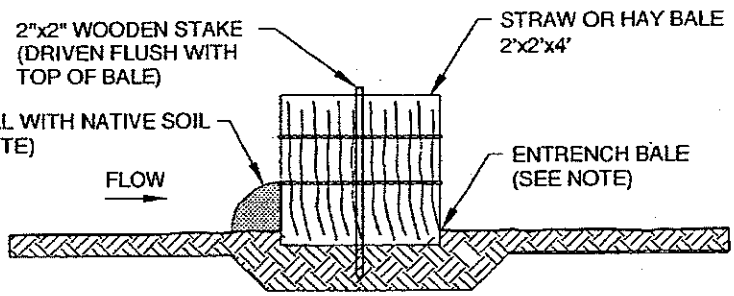
Installation: Bales will be placed in a single row with the contour along the limits of the work area with ends tightly abutting. Hay bales should be placed approximately 6 feet beyond the toe of the slope to allow for sediment accumulation; between disturbed areas and down gradient environmental resource areas; at the base of all slopes adjacent to wetland resource areas; and the inlet and outlet of open drainage structures. Hay bale use in drainage swales as check dams shall be limited to drainage areas of 1/2 acre or less.

Maintenance: Inspection will be made daily in areas of active construction, following each major storm event, and following construction and repair or replacement will be made to retain proper functioning until revegetation is complete. Additional hay bales will be stockpiled on site for replacement purposes.

Specification: Bales should be bound around the sides with string placed horizontally to prevent deterioration of the bindings (see Figure 21). Except at equipment and/or road crossings, bales will be entrenched unless the ground surface consists of rocky soils or ledge, or there are many large tree roots within the top 4 inches of soil. Uphill backfilling only will be acceptable in those situations. As subsurface conditions allow, the bales will be securely anchored with two (2" × 2" × 4') wooden stakes driven flush with the top of the bale. Gaps should be chinked (filled with loose straw or hay). Hay bales must be removed upon permanent revegetation.



PLAN VIEW
N.T.S.



CROSS-SECTION
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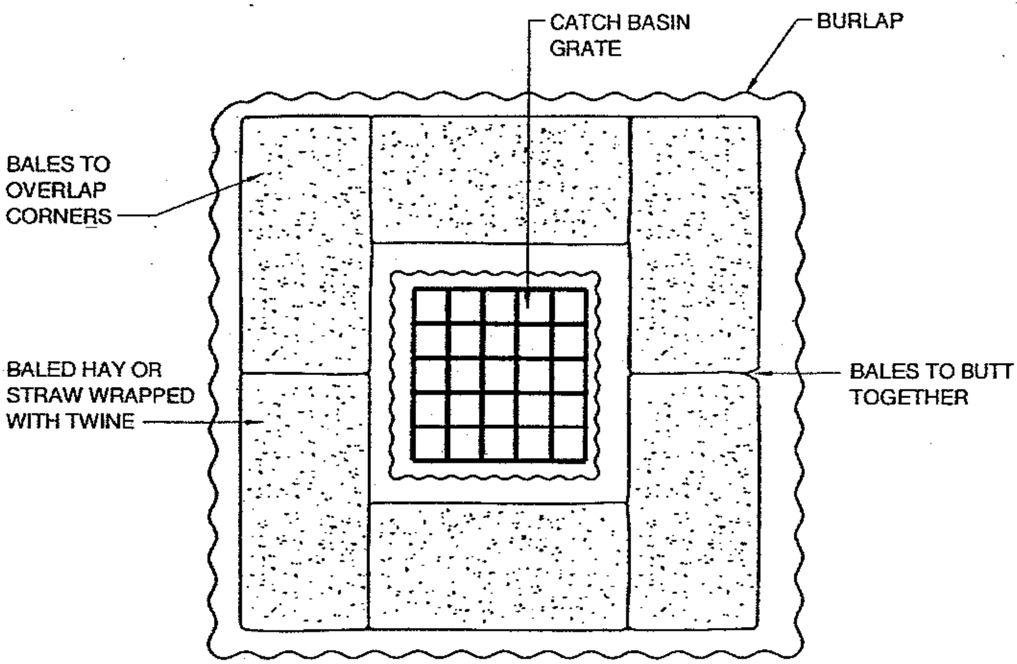
CONSTRUCTION SPECIFICATIONS

1. BALES SHALL BE PLACED AT THE TOE OF A SLOPE ON THE CONTOUR AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. TRENCH IN BALE EXCEPT WHERE LEDGE IS ECOUNTERED, WHERE SOIL IS ROCKY, OR WHERE MANY LARGE TREE ROOTS ARE ENCOUNTERED.
3. WHERE ENTRENCHMENT IS NOT POSSIBLE, EACH BALE SHALL BE BACKFILLED WITH NATIVE SOIL ON THE UPSLOPE SIDE A MINIMUM OF FOUR (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL.
4. BALES SHALL BE SECURELY ANCHORED IN PLACE BY TWO WOODEN STAKES DRIVEN THROUGH THE BALE. THE FIRST STAKE SHALL BE DRIVEN TOWARD THE PREVIOUS LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER.
5. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.

Maritimes & Northeast Pipeline	Straw/Hay Bale Barrier	Figure 21 Date: March, 1999

ev. 04678 4678-7



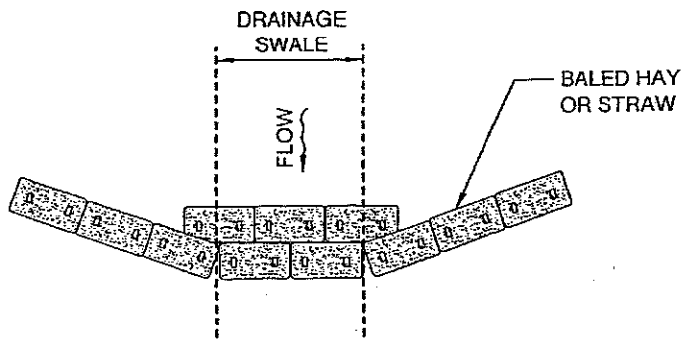
NOTE:

1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH HAY BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED. ACCUMULATED SEDIMENTS SHALL BE REMOVED.
2. HAYBALES PLACED ON PAVEMENT SHALL HAVE BURLAP PLACED BETWEEN PAVEMENT AND HAY BALE.
3. BLOCK AND GRAVEL DROP INLET SEDIMENT FILTER CAN BE USED IN LIEU OF HAY BALES.

N.T.S.

Maritimes & Northeast Pipeline	Storm Drain Inlet Protection	**Figure 22** Date: **March, 1999**

ev. 04678 4678-3



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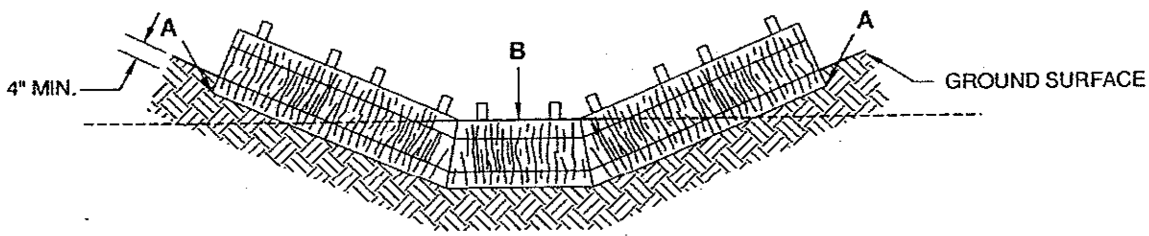


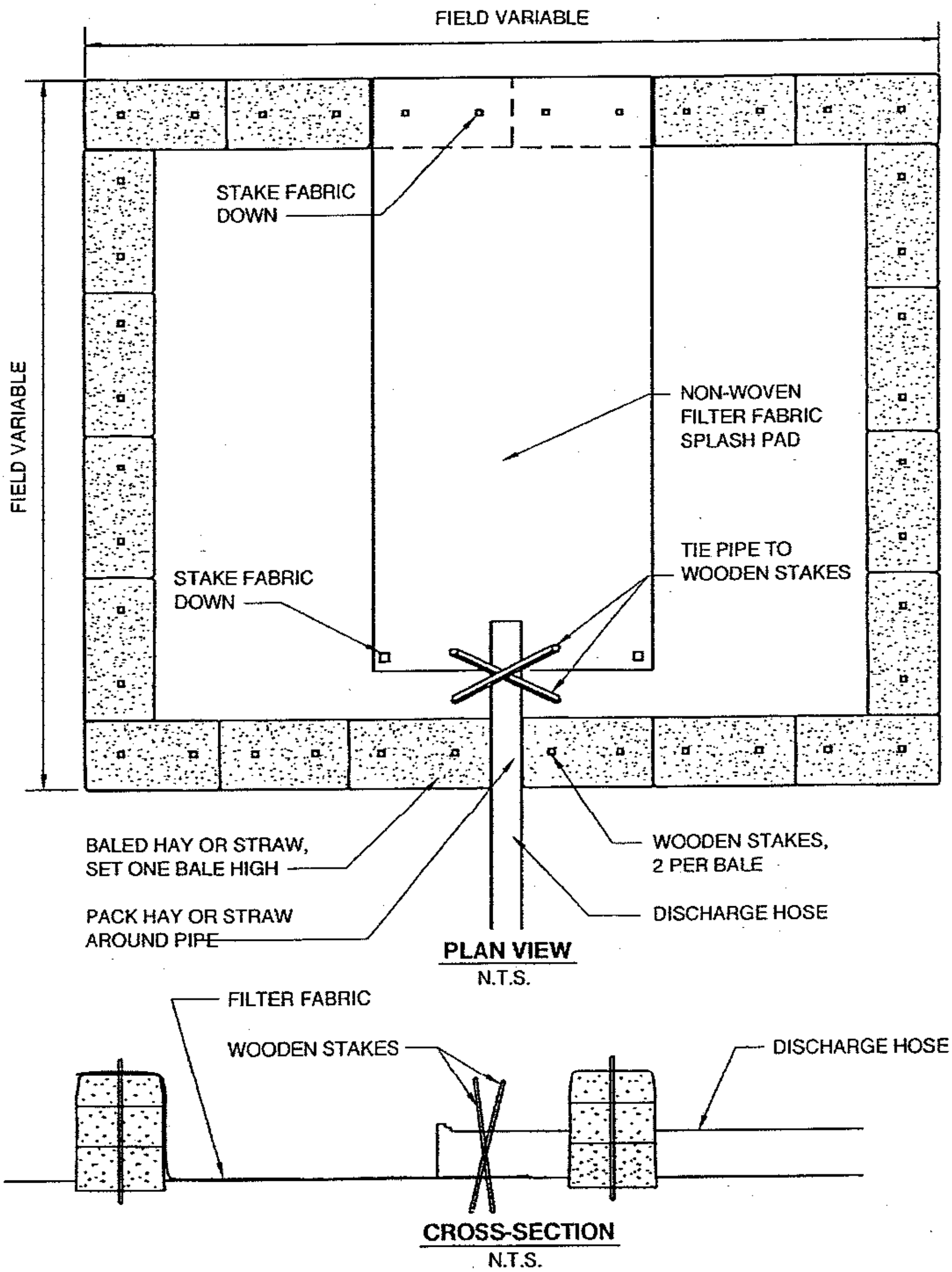
POINTS A SHALL BE HIGHER THAN POINT B

CROSS-SECTION
N.T.S.

NOTE: PLACEMENT OF STRAW BALE BARRIER CHECK DAM IS LIMITED TO CHANNELS DRAINING AREAS LESS THAN 1/2 ACRE. STONE CHECK DAMS MAY BE USED FOR LARGER DRAINAGE AREAS.

Maritimes & Northeast Pipeline	Proper Placement of Straw Bale Barrier Check Dam In Drainage Way	**Figure 23** Date: **March, 1999**

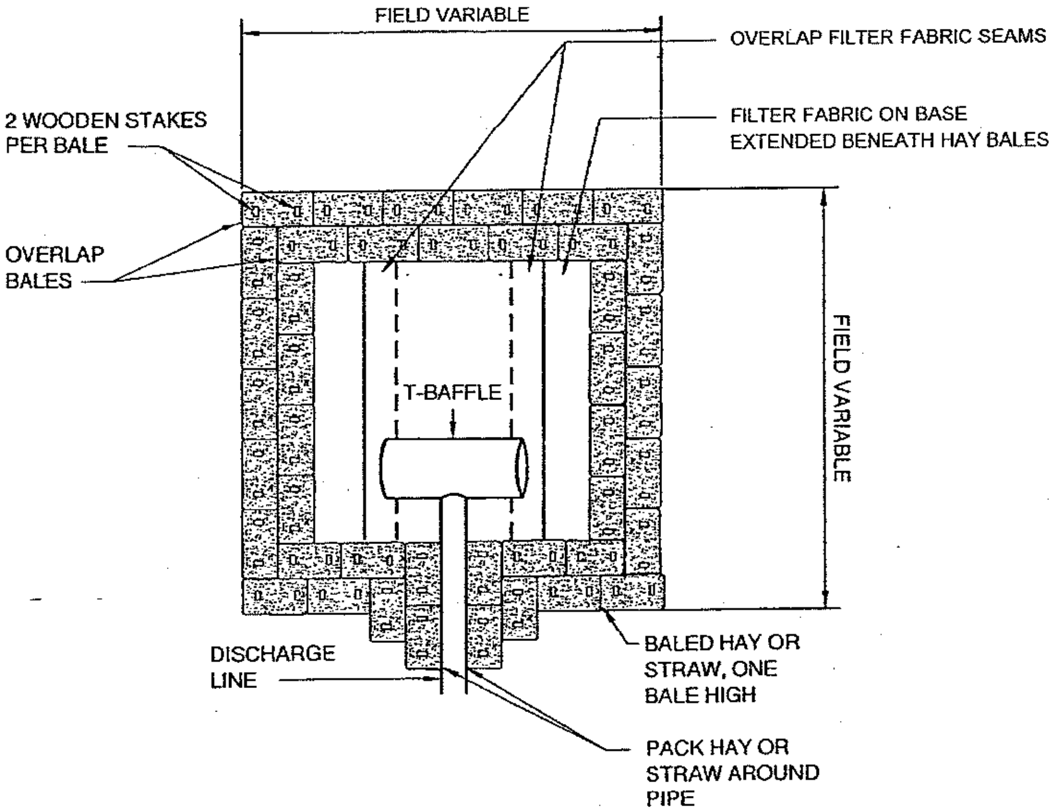
ev. 04678 4678-1



NOTE: NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS.
OTHER CONFIGURATIONS MAY BE REQUIRED / APPROVED BY THE ENVIRONMENTAL INSPECTOR.

Maritimes & Northeast Pipeline	Hay/Straw Bale Settling Basin	**Figure 24** Date: **March, 1999**

ev. 04678 4678-24



PLAN VIEW
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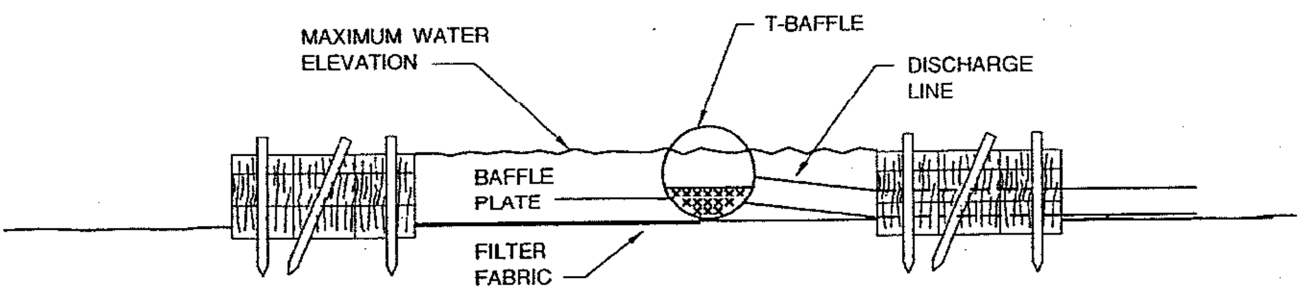
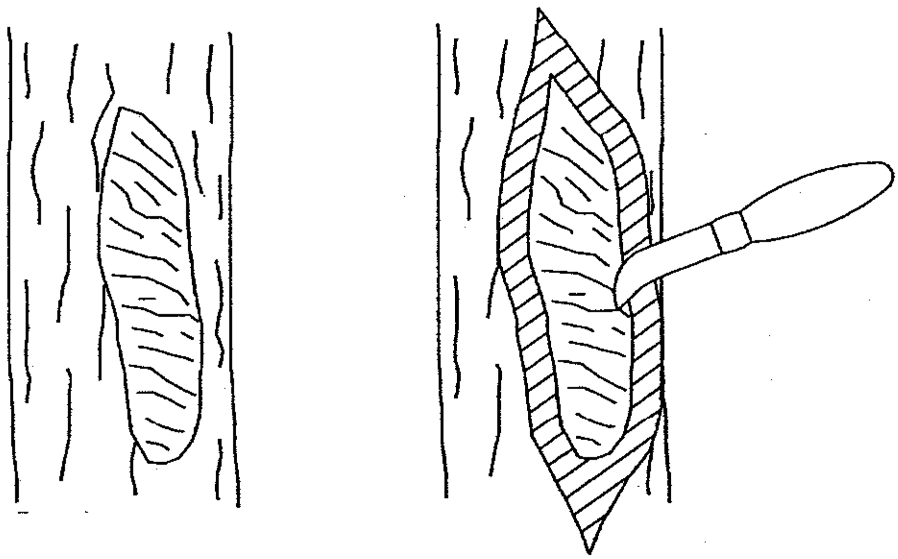


CROSS-SECTION
N.T.S.

NOTES
1. PLACE DEVICE IN WELL VEGETATED AREA
2. NUMBER OF HAY BALES MAY VARY DEPENDING ON SITE CONDITIONS.

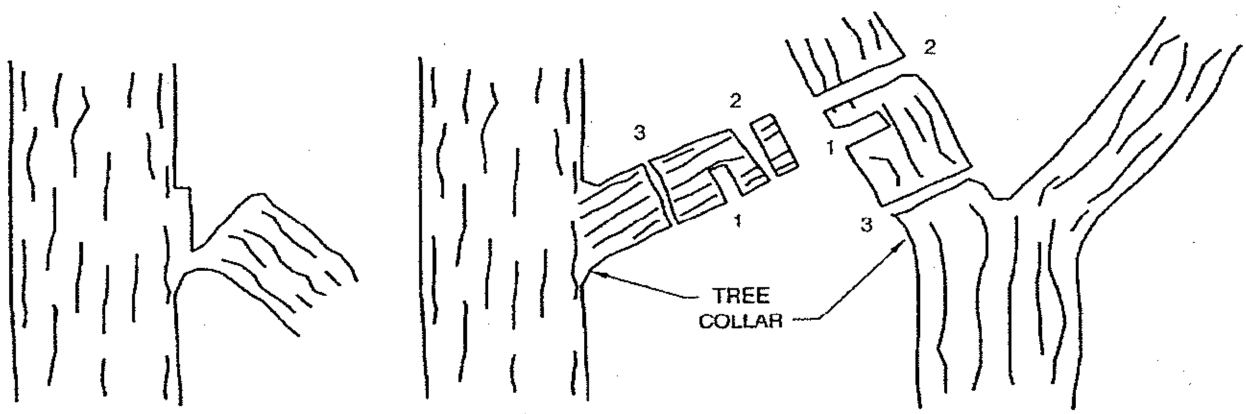
Maritimes & Northeast Pipeline	Typical Hydrostatic Discharge Settling Basin	Figure 25 Date: March, 1999

ev. 04678 4678-17



TREE WOUND TRIM AND TAPER

TRACING BARK WOUNDS



INCORRECT CORRECT CORRECT

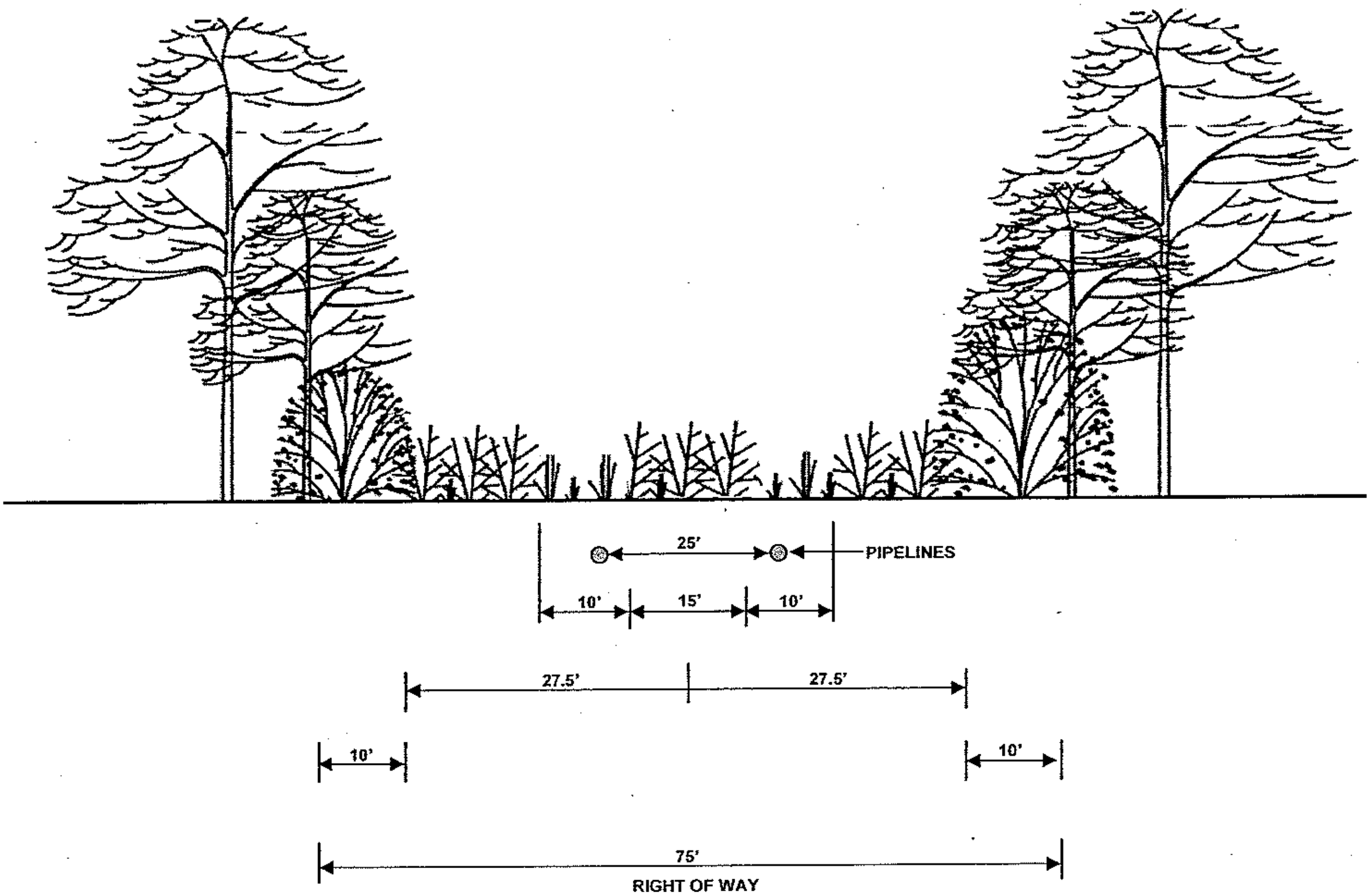
A. CUT THROUGH #2 AND LEAVE A 3 TO 6" NUB,

B. CUT NUB OFF

PRUNING DAMAGED BRANCHES

Maritimes & Northeast Pipeline	Tracing and Pruning Tree Damage	**Figure 26** Date: **March, 1999**

ev. 04678 4678-19



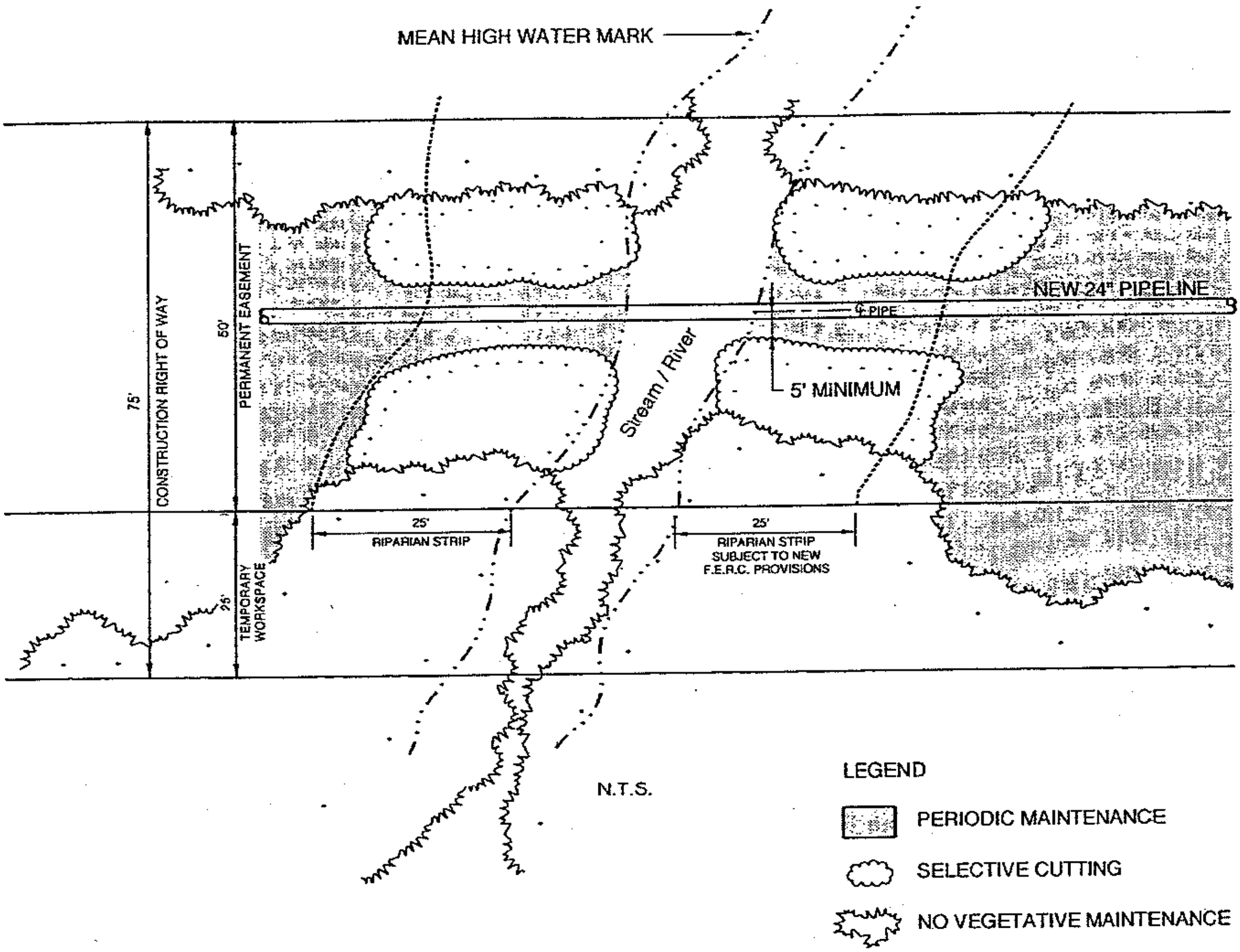
N.T.S.

NOTES:

1. MAINTENANCE OF R.O.W. IN HERBACEOUS STATE PERMITTED IN A 10' CORRIDOR CENTERED OVER EACH PIPELINE.
2. SELECTIVE HAND CUTTING OF TREES GREATER THAN 15' TALL PERMITTED WITHIN 15' OF EITHER PIPELINE.
3. NO VEGETATION MAINTENANCE PERMITTED BEYOND 15' FROM EITHER PIPELINE.

Maritimes & Northeast Pipeline	**Wetland Vegetation Maintenance on Typical Loop Right-of-Way**	**Figure 27** **Date: Revised March 2006**

ev. 04678 4678-31



NOTES:

1. MAINTENANCE OF R.O.W. IN HERBACEOUS STATE PERMITTED IN A 10' CORRIDOR CENTERED ON THE PIPELINE.
2. SELECTIVE HAND CUTTING OF TREES GREATER THAN 15' TALL PERMITTED WITHIN 15' OF THE PIPELINE.
3. NO VEGETATION MAINTENANCE PERMITTED BEYOND 15' FROM THE PIPELINE.

Maritimes & Northeast Pipeline	Vegetation Maintenance Practices Within Wetlands and Riparian Corridors	**Figure 28** Date: **March, 1999**

EV. 04678 4678-33A

Device: Silt Fence

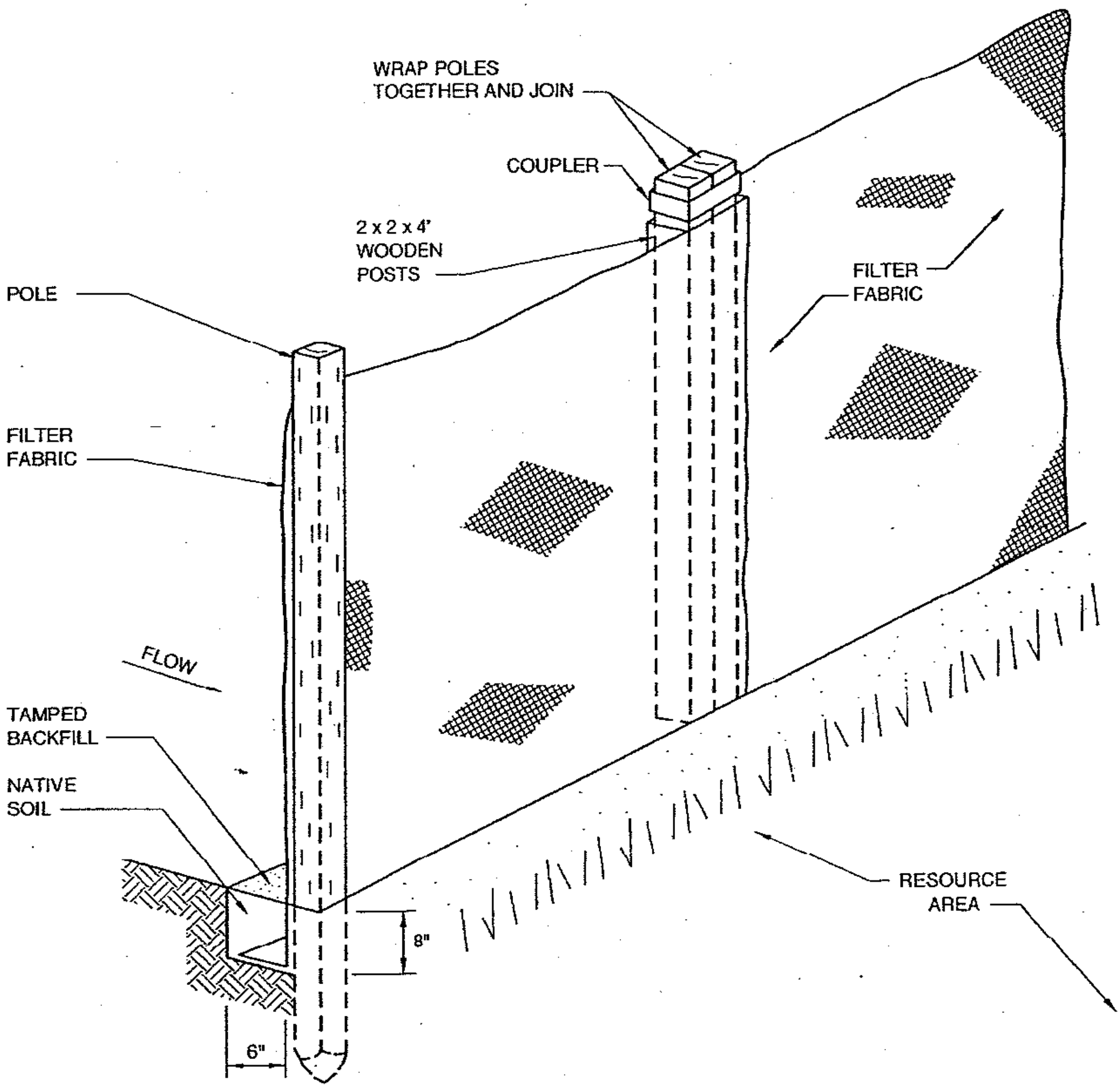
Application:
Temporary sediment filter device
May be used in conjunction with hay bales
Stormwater drain inlet protection
Settling basin filter device
Diversion outlet protection

Description: A temporary barrier of geotextile fabric used to intercept sediment laden runoff from small drainage areas. Sedimentation control is accomplished by reducing runoff velocity and trapping transported sediment at the outlet end of slope breakers and upslope of road and stream crossings. Silt fence also provides a visual and physical barrier defining project limits.

Installation: Silt fence will be placed in a single row with the contour or along the limits of the work area. Silt fence should be placed approximately 6 feet beyond the toe of the slope to allow for sediment accumulation; between disturbed areas and down gradient environmental resource areas; at the base of all slopes adjacent to wetland resource areas; and the inlet and outlet of open drainage structures. Silt fence may be installed backed with straw/hay bales for additional control of erosion and sedimentation.

Maintenance: Inspection will occur daily in areas of active construction, following each major storm event, and following construction and repair or replacement will be made to retain proper functioning until revegetation is complete. Additional silt fence will be stockpiled on site for replacement purposes.

Specification: The fabric will be securely fastened to wooden posts (2" × 2" × 4') with wire or staples. Posts will be spaced a maximum of 10 feet. Spacing will be reduced, if necessary, to prevent sagging of the fence. Joints will overlap a minimum of 6 inches. A trench will be excavated approximately 6 inches wide and 6 inches deep along the post line with 8 inches of fabric placed in the trench and backfilled (see Figures 29, 30, and 31). In areas where conditions prohibit trenching due to ledge, rocky soil, or many large tree roots within the top 4-inches of soil, sandbags or backfilling may be used to secure the bottom of the fence. The American Society of Testing Materials ("ASTM") has specified minimum standards for geotextile fabric used for sediment control. The fabric shall conform to the following standards:



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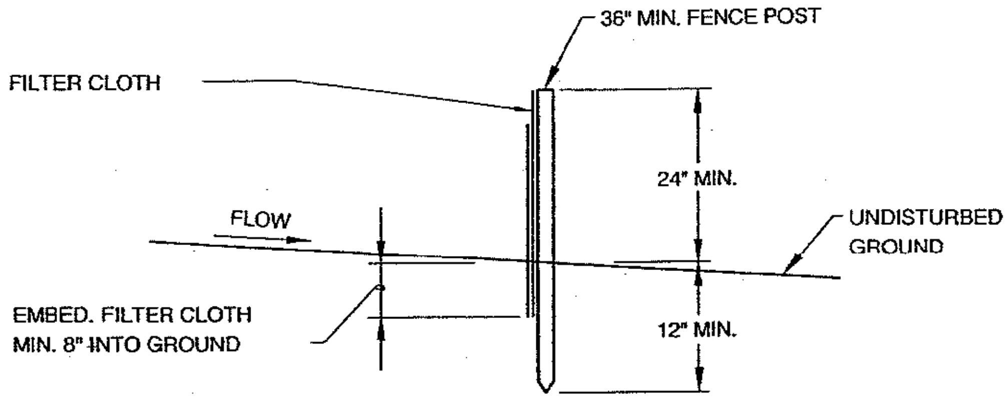
Maritimes & Northeast Pipeline	Silt Fence Detail	Figure 29 Date: March, 1999

ev. 04678 4678-16



CROSS-SECTION
N.T.S.

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. FILTER CLOTH SHALL BE FASTENED SECURELY TO WOODEN FENCE POSTS WITH WIRE TIES OR STAPLES AND SHALL BE SPACED EVERY 10 FEET.
2. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
3. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: 2" HARDWOOD

FILTER FABRIC: FILTER X, MIRAFI 100X, STABILINKA T140N OR APPROVED EQUAL.

PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR APPROVED EQUAL.

Maritimes & Northeast Pipeline	Silt Fence Barrier	Figure 30 Date: March, 1999

ev. 04678 4678-8

SILT FENCE CRITERIA

Property	Requirement
Grab Strength	100 lbs.
Elongation	15% Min. to 50% Max.
Permissivity	0.2 sec. -1
A.O.S. (Apparent Opening Size)	30-80 (coarse soils)* 50-80 (Fine soils)
Ultraviolet Resistance	70% Minimum

* Coarse soils with less than 50 percent of the particles passing through a #200 sieve, fine soils with greater than 50 percent of the particles passing through a #200 sieve.

The following are general guidelines for silt fence to be installed at the base of slopes adjacent to road crossings where vegetation has been disturbed within the following distances from the road:

INSTALLATION OF TEMPORARY SEDIMENT BARRIER

Slope	Minimum undisturbed cover
< 5%	25 feet
5 - 15%	50 feet
15 - 30%	75 feet
> 30%	100 feet

Device: Silt Curtain/Silt Boom

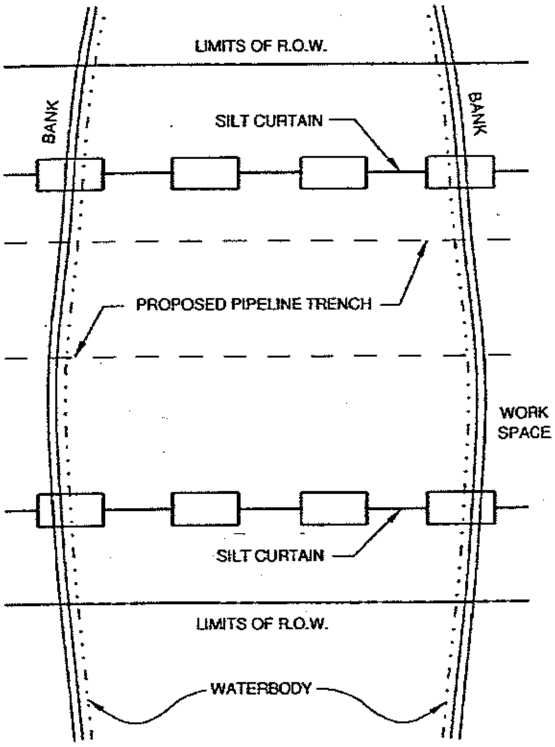
Application: Waterbody crossings

Description: A silt curtain (boom) comprised of a geotextile fabric, may be used where construction occurs on a bank or within a waterbody. A silt curtain will not prevent the water from being turbid during construction but will contain coarse sediment.

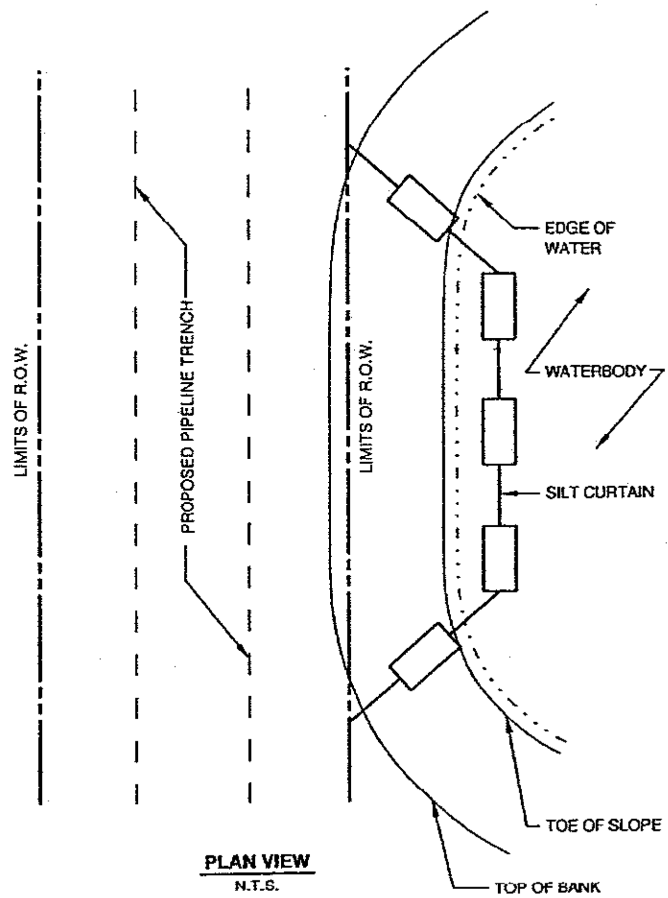
Installation: The silt curtain is a filter fabric installed across a waterbody to control coarse sediment by creating a settling area (see Figure 32). The curtain should be placed as close to the work area as possible and obstruct the flow of water as little as possible to avoid failure.

Maintenance: Repair or replacement will be made to insure proper functioning. Accumulated sediments, if accessible, may be removed prior to curtain removal.

Specification: The fabric will be securely fastened to wooden posts on the banks with wire or staples. Joints will be overlapped 6 inches. The fabric will be entrenched 6 inches, or securely anchored to the bottom using a chain attached to the bottom of the curtain, rocks, rock bags, or sandbags. Environfence mirafi 700x or approved equal may be used. Floats shall be securely attached to the fabric.



PLAN VIEW
N.T.S.



PLAN VIEW
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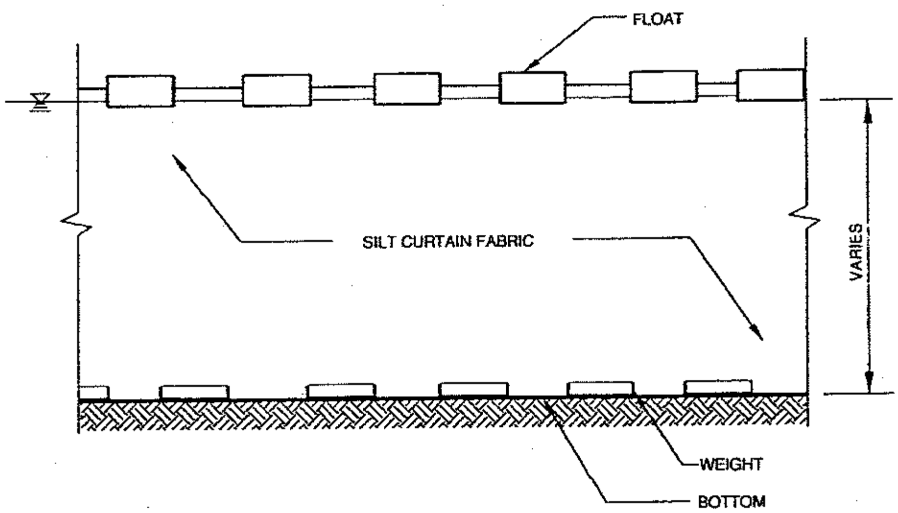


PROFILE
N.T.S.

Maritimes & Northeast Pipeline	Silt Curtain Detail	**Figure 32** Date: March, 1999

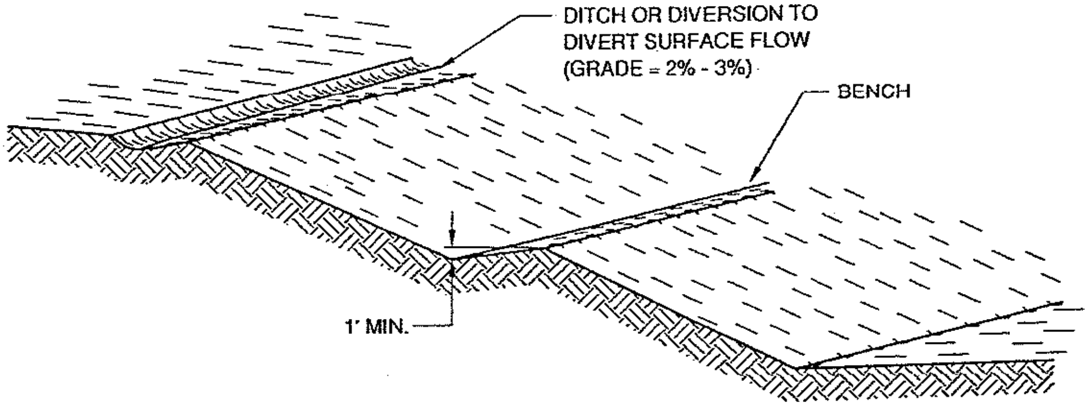
ev. 04678 4678-27

Device:	Slope breaker/Diversion Berm
Application:	Runoff diversion
Description:	Temporary or permanent slope breaker/diversion berms will be useful for the management of surface water flow. Berms will placed at specified intervals depending on the slope in order to trap and divert sheet flow off the ROW to a stable area.
Installation:	Temporary slope breakers are to be installed on all disturbed area, as necessary to avoid excessive erosion. Temporary slope breakers are to be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from any waterbody, wetland or road crossing. Permanent slope breakers are also to be installed and maintained on all disturbed areas (except agricultural areas and lawns) and at the base of slopes greater than 5 percent that are less than 50 feet from any waterbody, or as needed to prevent sediment transport into the waterbody. Permanent slope breakers are to be installed just downslope of trench breakers where possible to divert groundwater that may make its way to the surface. Slope breakers are typically constructed of compacted earth and rock but are sometimes constructed with earth filled sacks and/or staked hay bales or other functionally equivalent material where appropriate.. On long slopes, a series of berms will be used (See Below). Runoff water will be filtered at the outlet end by discharging into a well vegetated area or energy dissipating device typically constructed of a haybale and/or silt fence filter. Slope breakers may extend slightly (about 4 feet) beyond the edge of the construction ROW to effectively drain water off of the disturbed area.
Maintenance:	During and following construction, slope breaker/diversion berms will be inspected to insure proper functioning. Sediments will be removed from the ditchline and repairs made as necessary. The channel will be kept cleared of debris and obstructions.
Specification:	The berm shall be free of brush and stumps and other debris. Each berm will have a minimum height of 18 inches after compaction and a minimum width of 36 inches to ensure structural integrity and to allow easy passage of construction equipment. Permanent slope breakers will not be installed on agricultural or residential land unless authorized by the landowner. Upon specific approval by FERC or other applicable agency, some areas may not require slope breakers such as slopes in rocky areas that contain shot rock. Fill shall be compacted as needed to prevent unequal settlement. In highly erosive areas, the spacing of the

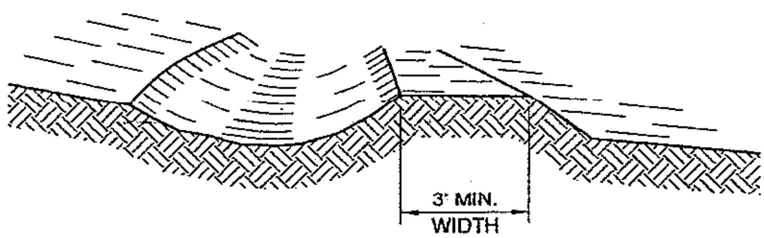
slope breakers may be reduced to minimize erosion. Following construction, the berm will be seeded and mulched accordingly (see Figure 33). Slope breakers must have a 2 to 8 percent outslope and be located so that they will outlet to a vegetated area without causing water to pool or erode behind the breaker. However, if no vegetation is present within a reasonable distance of where a slope breaker must be located to properly function, then an energy dissipating device, typically consisting of haybales, sandbags, silt fence, and or crushed stone, must be constructed at the outlet. With the preceding comments accounted for, construct and maintain the breakers at the following spacing:

SPACING OF SLOPE BREAKERS	
SLOPE	***SPACING***
5 - 15%	300 feet
15 - 30%	200 feet
> 30%	100 feet

Note: The spacing of slope breakers may be reduced as directed by an Environmental Inspector.



PLAN VIEW
N.T.S.



CROSS-SECTION
N.T.S.

1. ALL TREES,BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE DIVERSION.
2. FILLS SHALL BE COMPACTED AS NEEDED TO PREVENT UNEQUAL SETTLEMENT THAT WOULD CAUSE DAMAGE IN THE COMPLETED DIVERSION.
3. ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED FOLLOWING FINISHED GRADING.
4. DIVERSION CHANNEL SHOULD BE LINED WITH EROSION CONTROL FABRIC AS SOIL CONDITIONS REQUIRE.
5. THE OUTLET OF THE SLOPE BREAKER MUST BE STABILIZED BY INSTALLING A HAYBALE/SILT FENCE DISSIPATING DEVICE OR SYNTHETIC GEOMAT. THE GEOMAT WILL CONSIST OF A GEOTEXTILE FABRIC 8 FEET WIDE AND 10 FEET LONG. IF USED, THE END OF THE FABRIC AT THE RIGHT-OF-WAY MUST BE TOED INTO THE GROUND. AN ENERGY DISSAPATING DEVICE (CRUSHED STONE) MUST BE PLACED AT THE UP-SLOPE EDGE OF THE GEOMAT. IN ADDITION, HAY BALES MAY BE INSTALLED AT THE OUTLET TO FILTER SEDIMENT.

Maritimes & Northeast Pipeline	Slope Breaker/Diversion Berm	Figure 33 Date: March, 1999

Device: Trench breakers

Application: Runoff diversion

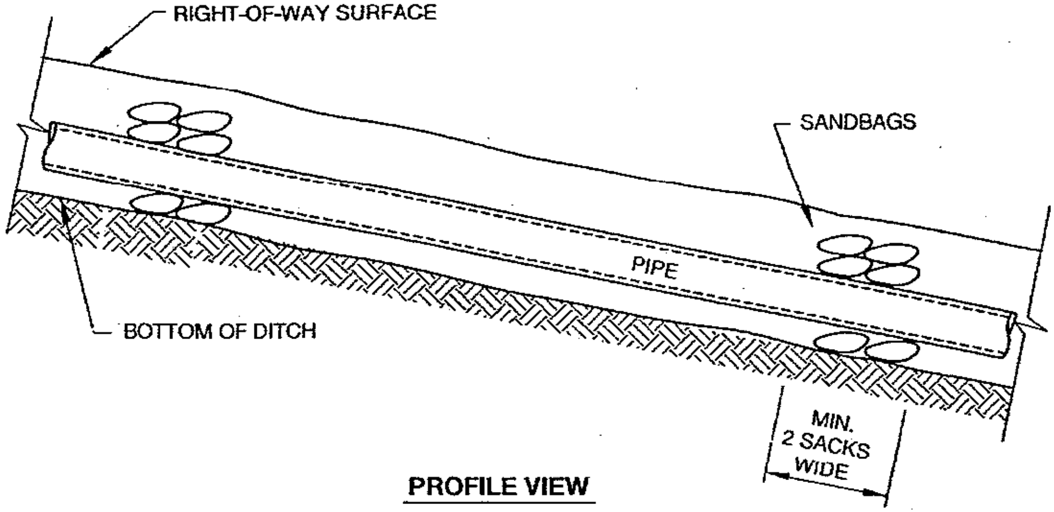
Description: Trench breakers are used to prevent erosive runoff velocities from developing in the backfilled trench around the pipeline following construction. Trench breakers will be placed around the pipe in the excavated trench at specified intervals depending on the slope in order to prevent the lateral movement of water along the pipeline and erosion of the ditch bottom.

Installation: Permanent trench breakers which typically consist of sandbags are placed around the pipe (but may consist of other material such as polyethelene foam) on long slopes greater than 5 percent. Trench breakers are also installed at base of slopes greater than 5 percent that are less than 50 feet from any waterbody or wetland, and at most road crossings.

Maintenance: None Required

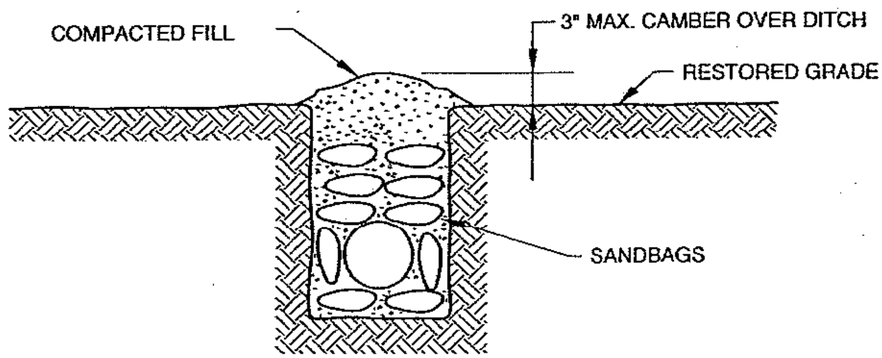
Specification: Trench breakers will be free of brush and stumps and other debris. Each breaker will be constructed and designed according to the trench dimensions and compacted to ensure structural integrity (see Figure 34). Under no circumstances shall topsoil, excavated from the ditch line or construction ROW, be used to fill sandbag trench breakers. Construct and maintain breakers at the following spacing:

SPACING OF TRENCH BREAKERS	
SLOPE	***SPACING***
5 - 15%	300 feet
15 - 30%	200 feet
> 30%	100 feet



PROFILE VIEW

N.T.S.



CROSS-SECTION

N.T.S.

GENERAL NOTES:

1. CONSTRUCT ON SLOPING TERRAIN.
2. INSTALL AS DITCH IS COMPLETED, AND LATER MODIFY TO ACCOMODATE PIPE INSTALLATION.
3. PRIOR TO LOWERING IN PIPE, REMOVE ALL DECOMPOSABLE MATERIAL AND LARGE ROCKS.
4. BREAKERS MAY BE COMPOSED OF SANDBAGS, OR OTHER APPROVED MATERIAL.
5. TRENCH BREAKERS SHALL BE PLACED IN ACCORDANCE WITH THE SPACING REQUIREMENTS FOR SLOPE BREAKERS AT A MINIMUM.
6. PERMANENT TRENCH BREAKERS ARE USUALLY INSTALLED JUST UPSLOPE OF PERMANENT SLOPE BREAKERS AND HAVE SAME SPACING REQUIREMENTS.

Maritimes &Northeast Pipeline	Trench Breaker	Figure 34 Date: March, 1999

ev. 04678 4678-9

Device: Clay Saddles

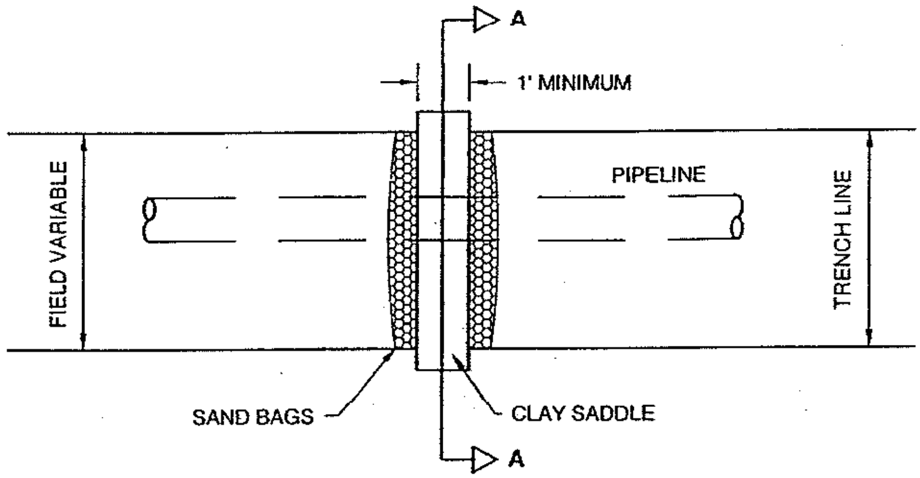
Application: Prohibit groundwater migration

Description: Clay saddles are used in site specific locations for the purpose of preventing the exterior of the pipeline and trench from functioning as a conduit for water flow. Clay saddles are generally composed of Bentonite clay (chips) due to its high shrink-swell characteristics.

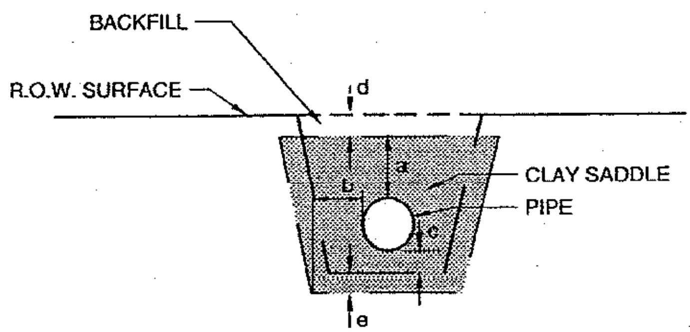
Installation: Once the pipe has been lowered into the trench, clay saddles will be installed in the trench around the pipeline as specified in applicable environmental permit conditions and approvals. Installation will occur under the direct supervision of the Environmental Inspector.

Maintenance: Precise installation is essential to insure proper function.

Specification: Clay saddles will be composed of Bentonite clay chips or approved equal. The Environmental Inspector requires approval of materials. Powdered or pelleted form is acceptable but not recommended due to additional cost and dust generation. Each saddle shall be constructed and designed according to the trench dimensions. Sandbags may be used to form the area where the clay saddle will be constructed (see Figure 35). Determine approximate amount of clay chips to be used. Bentonite chips are usually packaged in 50 pound bags (25 bags = 1 cubic/yard). Excavate an area completely around the pipe and dewater as necessary. Place clay material into dry trench so that the pipeline is completely surrounded. Avoid breathing dust. Use approved respirator and safety goggles. Do not add water. Backfill clay saddle when completed. The clay saddle shall extend to within 1 foot of the finished grade surface.



PLAN VIEW
N.T.S.



KEY

a. = 2' Minimum

b. = Field Variable

c. = 1' Minimum

d. = 1' Minimum

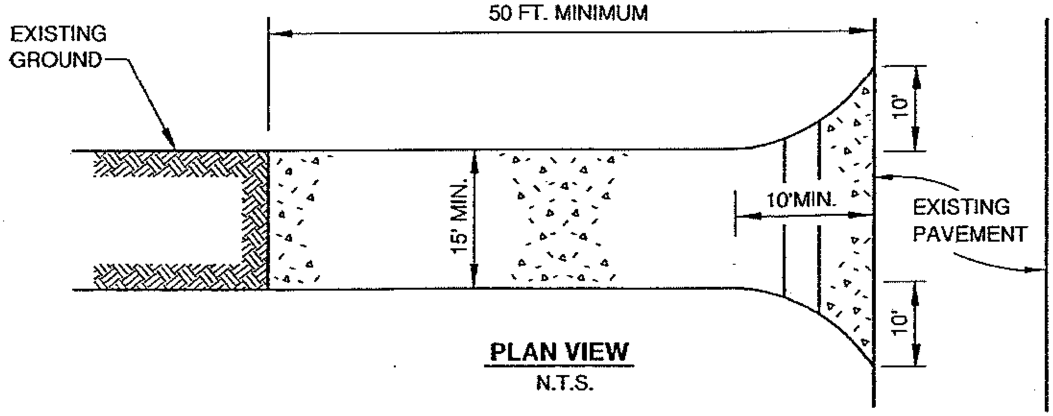
e. = 1' Minimum

SECTION A-A
N.T.S.

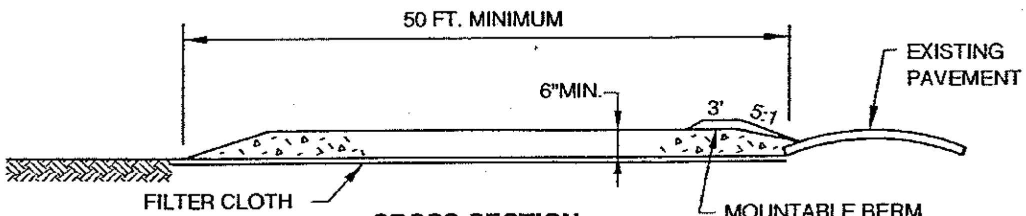
Maritimes & Northeast Pipeline	Typical Clay Saddle Installation	Figure 35 Date: March, 1999

ev. 04678 4678-28

Device:	Stabilized construction entrance
Application:	Road Crossings ROW Access Points
Description:	A construction entrance consists of a stone pad, mud rack, or other materials used to reduce the tracking or flowing of sediment off the ROW.
Installation:	Construction access roads will be installed in areas where mud can accumulate on vehicle tires and be carried onto road surfaces. Where entrances cross poorly drained locations or drainage ditches, a subsurface drain will be installed prior to constructing the stabilized entrance.
Maintenance:	The entrance will be maintained in a condition that will reduce tracking of sediment off the ROW. Periodic top dressing with additional stone will be accomplished as needed. Roads adjacent to the construction site will be cleaned at the end of each day, as needed. The entrance will be removed following the completion of construction.
Specification:	The disturbed area shall be free of brush, stumps and other objectionable material. Stone will be course aggregate with a minimum 2 inch size. Pad dimensions will be 50 feet long, 25 feet wide and 6 inches thick. In residential or active agricultural areas, the stone entrance will have a geotextile fabric placed beneath the stone (see Figure 36). This fabric shall consist of a durable tear resistant woven material.



PLAN VIEW
N.T.S.



CROSS-SECTION
N.T.S.

CONSTRUCTION SPECIFICATIONS

1. STONE SIZE - USE 2" STONE (MINIMUM SIZE), OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. LENGTH - RECOMMEND GREATER THAN OR EQUAL TO 50 FEET WHERE SOILS ARE SANDS AND GRAVELS AND 100 FEET IN SILTS AND CLAYS.
3. THICKNESS - NOT LESS THAN SIX (6) INCHES.
4. WIDTH - FIFTEEN (15) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
5. FILTER CLOTH - SHALL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE IN RESIDENTIAL OR ACTIVE AGRICULTURAL AREAS.
6. SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM SHALL BE PERMITTED.
7. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH SHALL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.
8. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED.

Maritimes & Northeast Pipeline	Stabilized Construction Entrance	Figure 36 Date: March, 1999

cv. 04678 4678-6

Device: Drainage tile protection

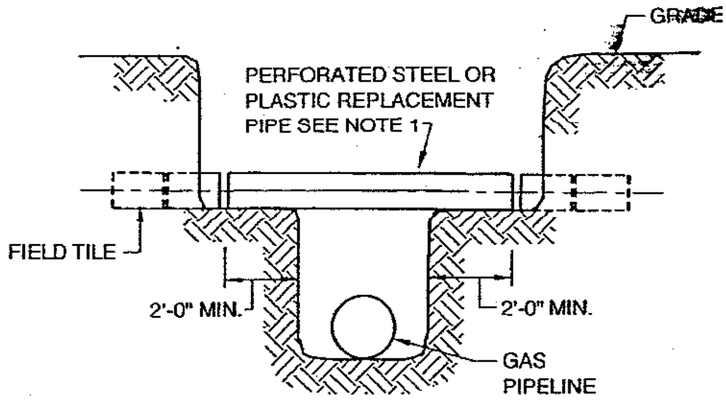
Application: Agricultural fields

Description: A drainage tile is a subsurface drainage structure used in agricultural areas to improve the productivity of the land. The contractor is responsible for identifying and clearly marking drain tiles prior to disturbance so the necessary protection and repairs can be made to ensure their proper function after construction.

Installation: To ensure that preconstruction subsurface drainage patterns are maintained in agricultural areas, drainage tile protection measures will be used. These will consist of either plastic or steel drainage conduits depending on site characteristics. Solid connector conduits will be installed in areas where soil properties indicate a severe settling problem.

Maintenance: Drainage tiles damaged during construction will be probed to determine if damage has occurred. Drainage tiles installed during construction will be maintained to provide sufficient subsurface drainage. In the event where excessive settlement deflects and damages the replacement tile, they will be removed and additional measures will be installed to ensure preconstruction drainage patterns.

Specification: The trench will be backfilled to the depth of the original drainage tiles and compacted to its original density to minimize settlement. The drainage tiles are then replaced and the trench backfilled. A solid connector pipe will be installed where settling may occur. The pipe will extend a minimum of 2 feet beyond the edge of the trench so that it will be resting on undisturbed soil (see Figure 37).



METHOD 1
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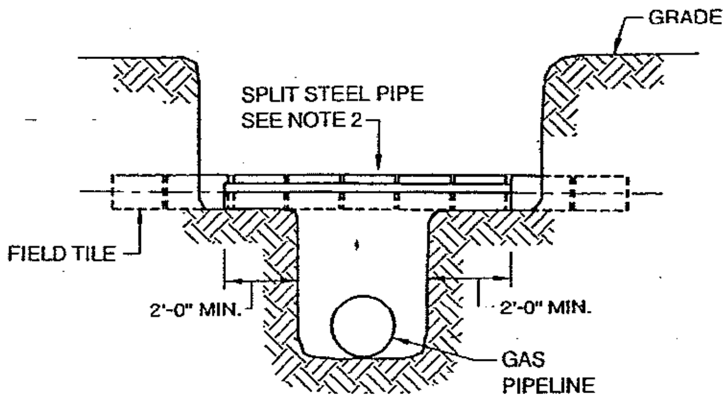

METHOD 2
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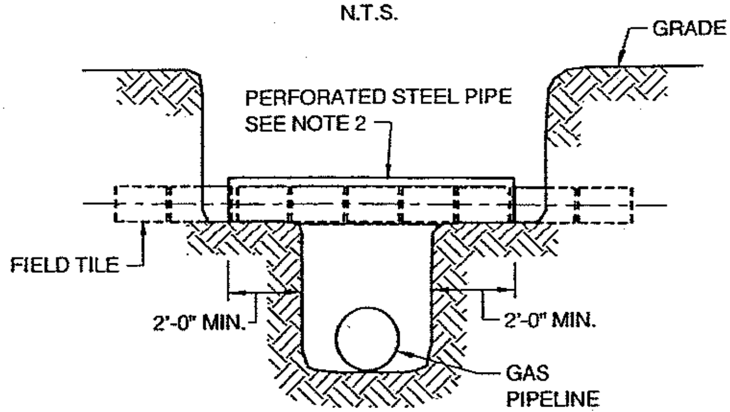


METHOD 3
N.T.S.

NOTES:
1. REPLACEMENT PIPE TO BE AS NEAR AS POSSIBLE TO THE DIAMETER OF THE FIELD TILE.
2. STEEL CARRIER PIPE TO HAVE INSIDE DIAMETER AS NEAR AS POSSIBLE TO THE OUTSIDE DIAMTER OF THE FIELD TILE.
3. MAINTAIN ORIGINAL FLOW LINE OF FIELD TILE IN ALL METHODS.

Maritimes & Northeast Pipeline	Typical Drainage Tile Protection	**Figure 37** Date: March, 1999

ev. 04078 4078-23

Device: Non-Woven Filter Bags

Application: Trench dewatering

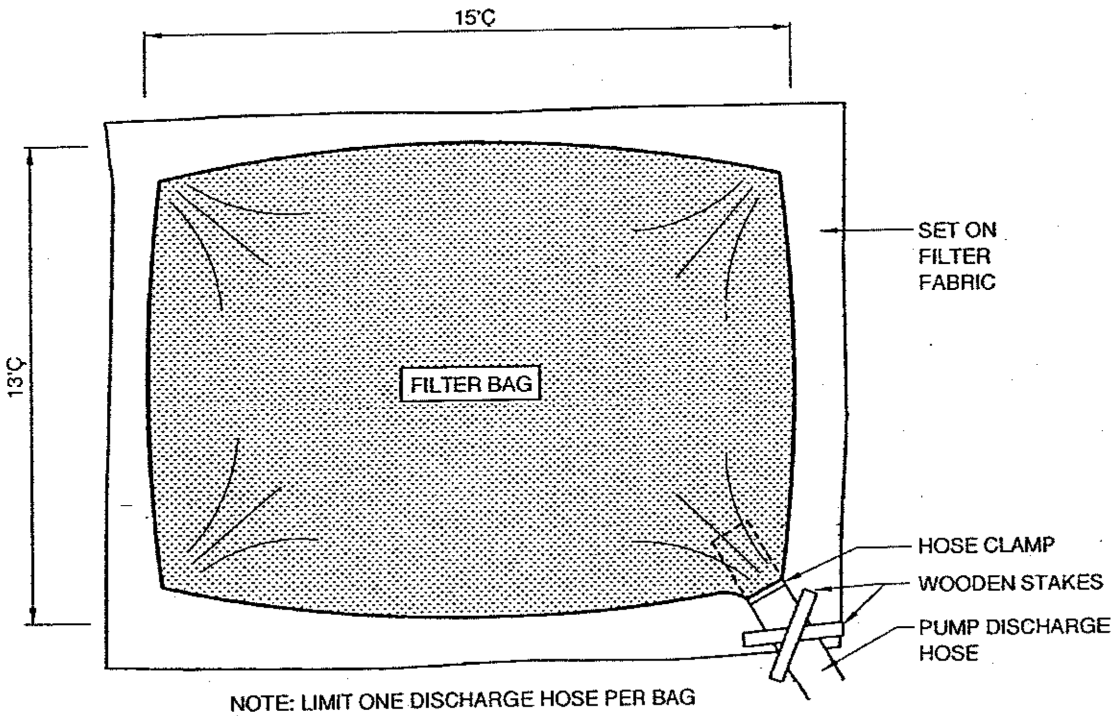
Description: Filter bags will be used as an effective filter medium to contain sand, silt and fines when trench dewatering. The wetland filter bag contains these materials while allowing the water to flow through the fabric.

Installation: The discharge point from trench dewatering must be vegetated (i.e. not impervious surface) to the maximum extent practicable, be at least 25 feet from the edge of a stream, river or lake, be on a slope of less than 20 percent, and be put through a non woven filter bag or sediment trap (hay bale lined pools, etc.). When a filter bag is placed within 250 feet of a waterbody (not wetland), the bag must be surrounded with secondary containment. In the case of wetlands, the discharge must meet the same criteria if the water can be easily pumped outside of the wetland. If the water can not be easily pumped outside of the wetland, then the water should be pumped through a filter bag or sediment trap before discharging into the wetland.

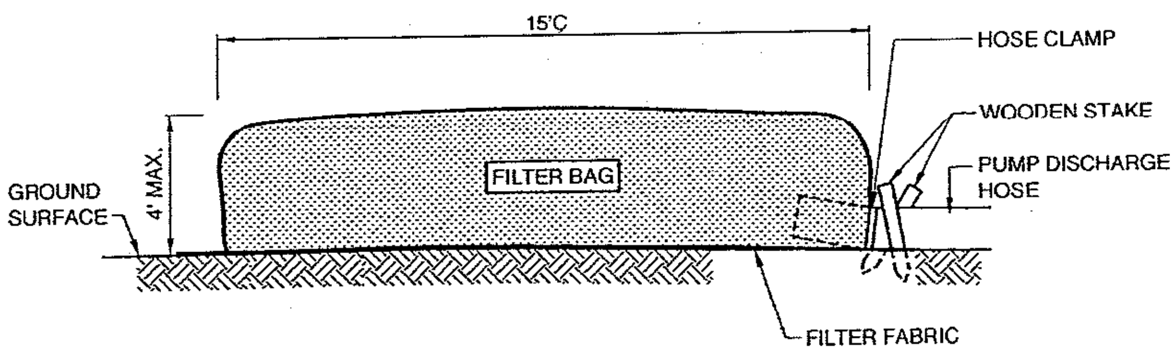
To insure proper installation, filter bags will be placed on relatively flat terrain free of brush and stumps to avoid ruptures and punctures. Proper installation requires cutting a small hole in the corner of the bag, inserting the pump discharge hose, and then securing the discharge hose to the bag with a hose clamp. Filter bags will be placed as far away from flowing streams and wetlands as practical, keeping in mind that they need to be accessible for removal after construction.

Maintenance: Prior to removing a bag from the hose, the bag will be tied off below the end of the hose allowing the bag to drain. Drainage will not be allowed through the inlet hole. To avoid rupture, the bags will be attended and pumping rates monitored. Once the bag is inflated to a height of 4 feet, pumping will stop to avoid rupture. Filter bags used during construction will be bundled and removed for proper disposal.

Specification: Filter bags are constructed of non-woven geotextile fabric. A maximum of one 6-inch discharge hose will be allowed per filter bag. Bag capacity will not be exceeded beyond 2,000 gallons per minute. Typical bag dimensions are 15 feet by 13.25 feet. To help prevent punctures, geotextile fabric may be placed beneath the filter bag when used in areas where wood debris or stones may cause the bag to puncture when it becomes weighted. Hose clamps will be used to secure the discharge hose, wire or string will not be used. (see Figure 38).



PLAN VIEW
N.T.S.



CROSS-SECTION
N.T.S.

Maritimes & Northeast Pipeline	Filter Bag	Figure 38 Date: March, 1999

ev. 04678 4678-18

Device: Dust control procedures

Application: Exposed soil

Description: Dust control methods will be employed to prevent the blowing and movement of dust through the application of temporary measures that are designed to reduce wind erosion.

Installation: In residential areas, construction roads, access points, and exposed soil surfaces will be moistened periodically with adequate water or other approved methods to control dust.

Maintenance: When temporary dust control methods are used, repetitive treatment will be applied as needed to accomplish control. Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.

Specification: The use of temporary mulch will reduce the need for dust control in areas that will remain disturbed for longer than 30 days. Water quality should be considered when materials are selected for dust control. The following are common methods of dust control. Other methods approved by the EIs may be used.

a. Water – The site may be sprayed with water until the surface is wet. Avoid erosive quantities of water.

b. Calcium Chloride – Granules or flakes may be applied at a rate that will keep the surface moist but not cause pollution. Used only when other methods are not practical. Calcium chloride will not be used within or adjacent to streams, water bodies, or wetlands.

Appendix A

Federal Energy Regulatory Commission Wetland and Waterbody Construction and Mitigation Procedures (01/17/03 Version)

APPENDIX A to
Maritimes and Northeast Pipeline
Phase IV Maine Facilities
Soil Erosion and Sediment Control Guidelines

FERC Wetland and Waterbody Construction and Mitigation Procedures
1/17/2003 Version

May be found at http://www.ferc.gov/industries/gas/enviro/wetland.pdf

Appendix B

Federal Energy Regulatory Commission Upland Erosion Control, Revegetation, and Maintenance Plan (1/17/2003 Version)

APPENDIX B to
Maritimes and Northeast Pipeline
Phase IV Maine Facilities
Soil Erosion and Sediment Control Guidelines

FERC Upland Erosion Control, Revegetation, and Maintenance Plan
1/17/2003 Version

May be found at http://www.ferc.gov/industries/gas/enviro/uplndctl.pdf

Appendix I

Proposed EMEC Transmission Line and Substation

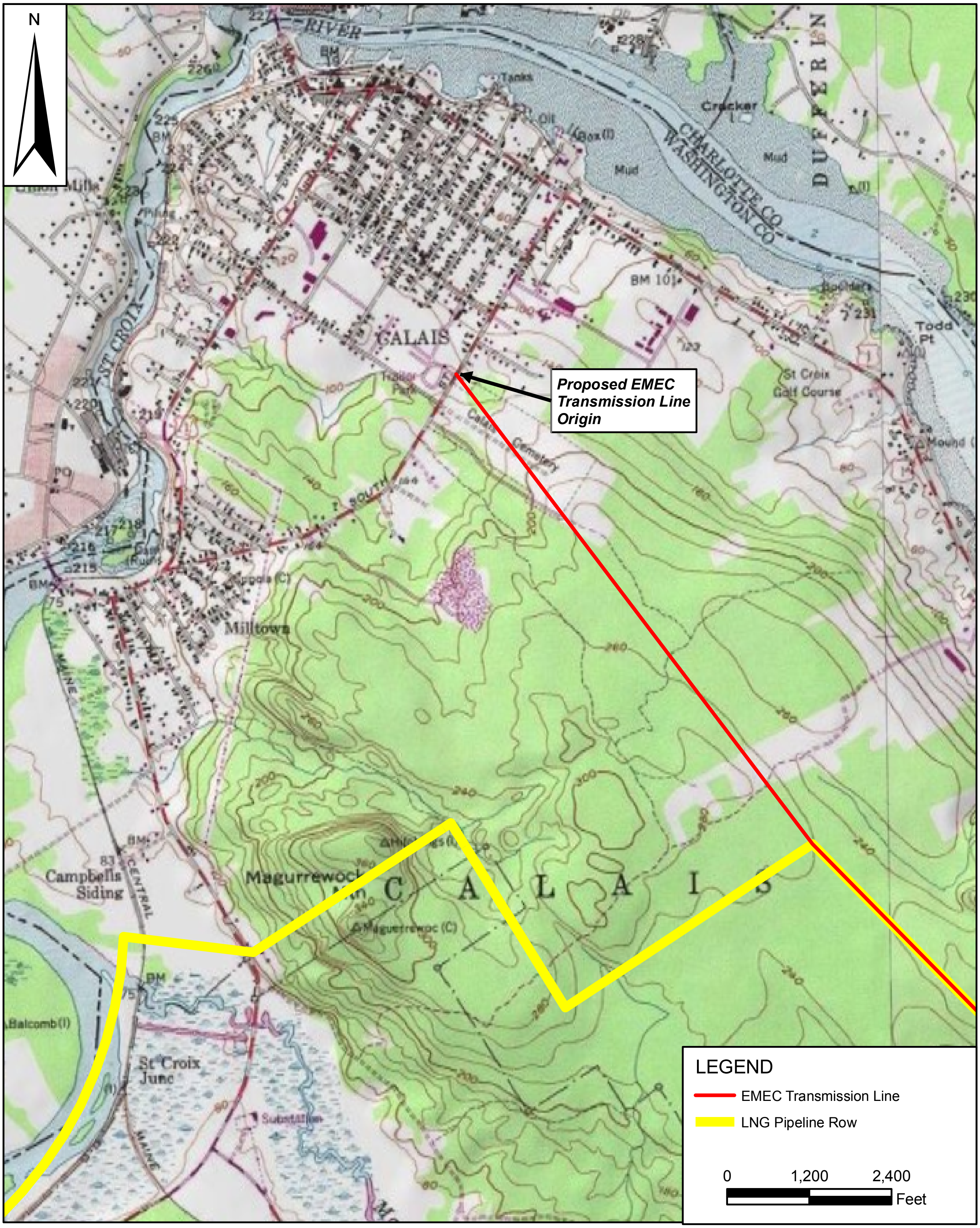


Figure I-1
Downeast LNG Project
Proposed EMEC Transmission Line and Substation: Sheet 1 of 4

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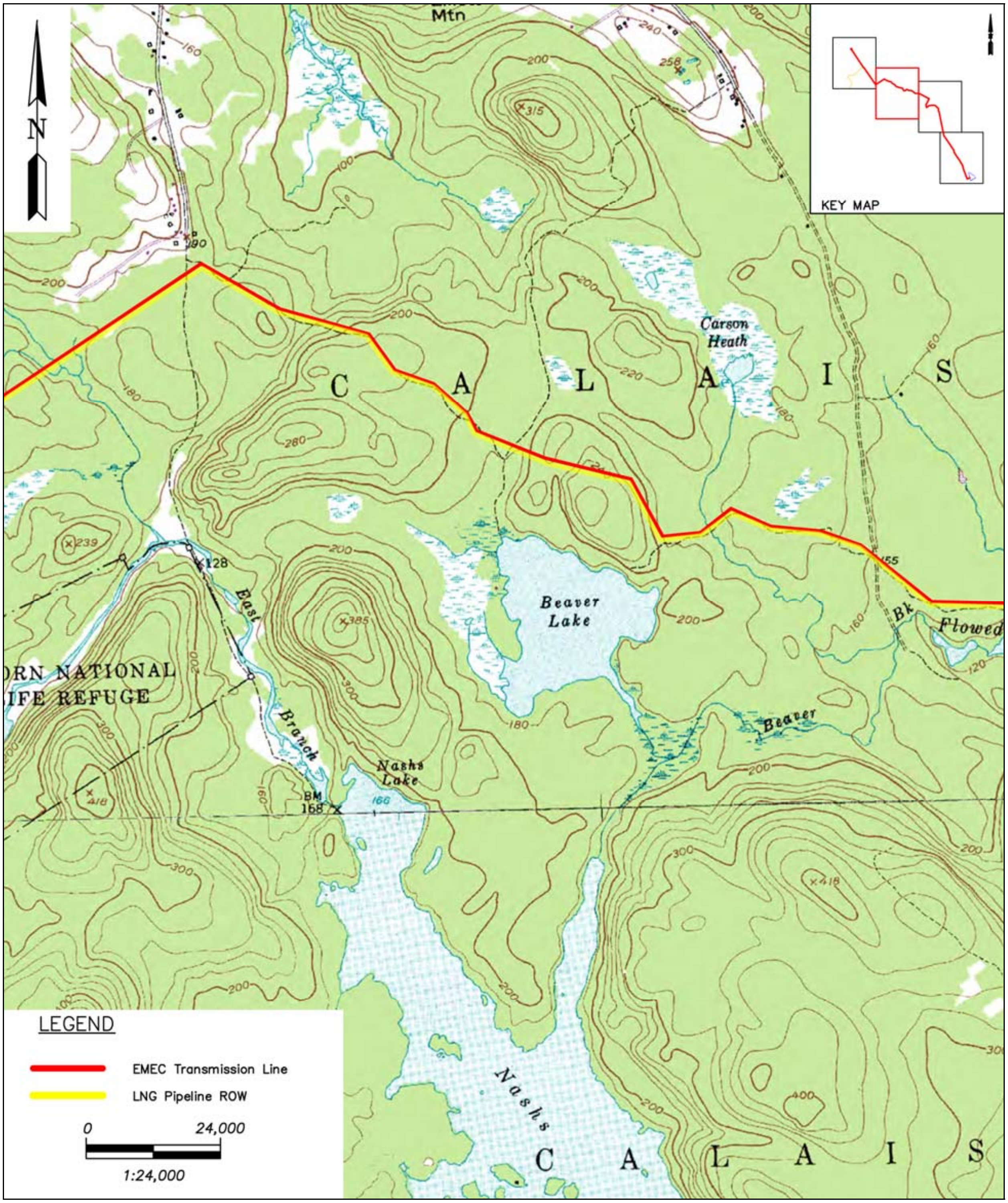

Figure I-2
Downeast LNG Project
Proposed EMEC Transmission Line and Substation: Sheet 2 of 4

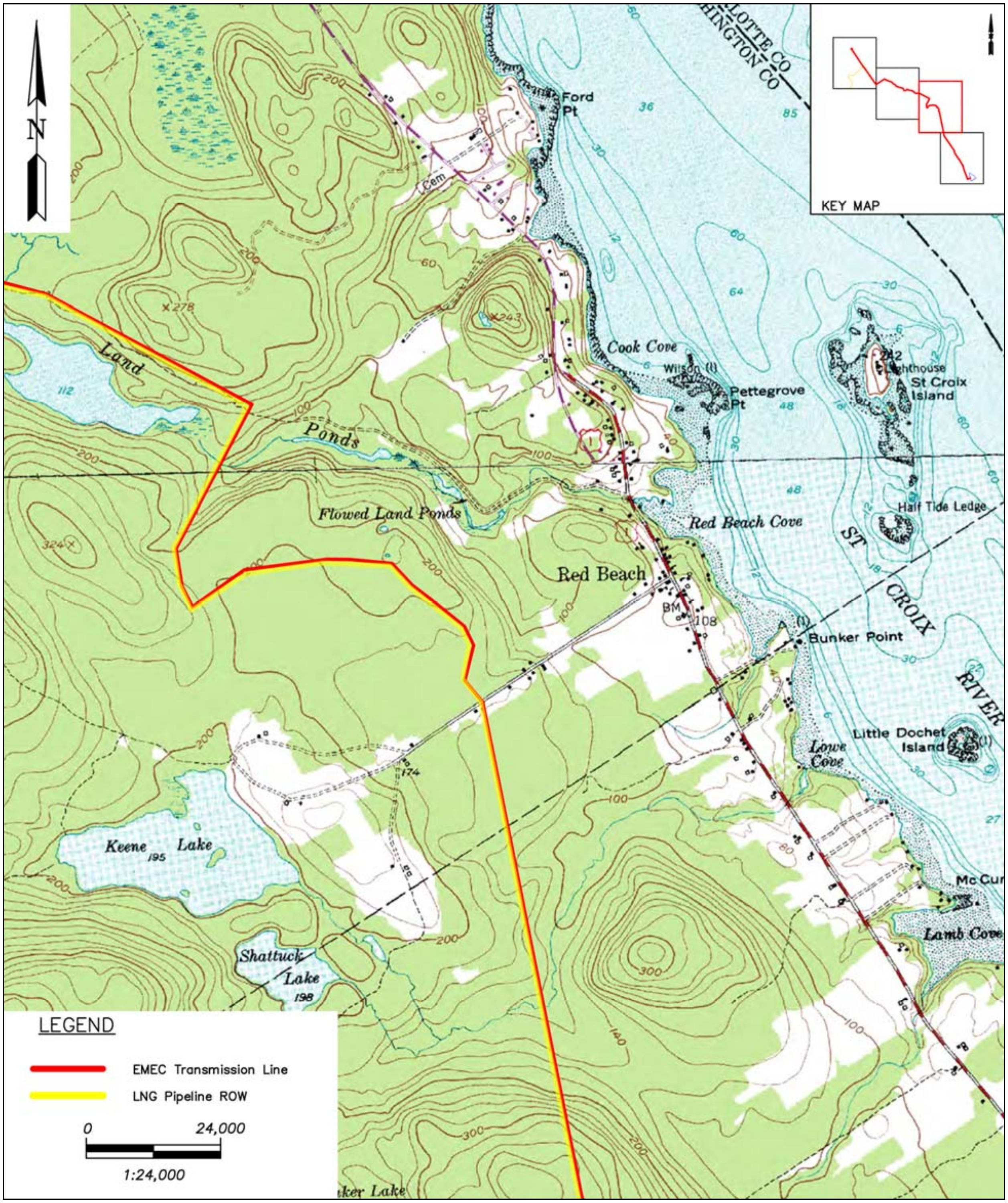

Figure I-3
Downeast LNG Project
Proposed EMEC Transmission Line and Substation: Sheet 3 of 4

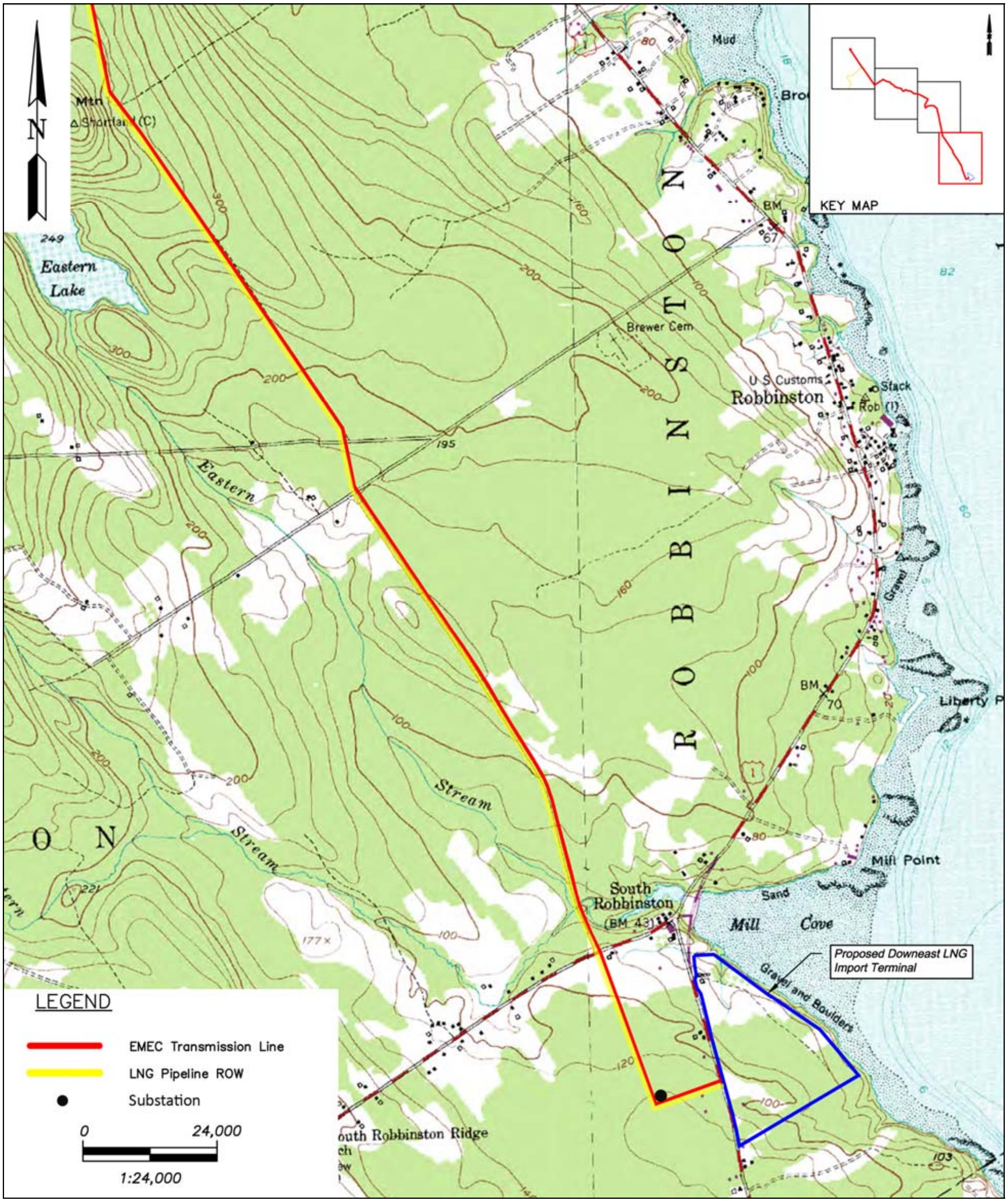

Figure I-4
Downeast LNG Project
Proposed EMEC Transmission Line and Substation: Sheet 4 of 4

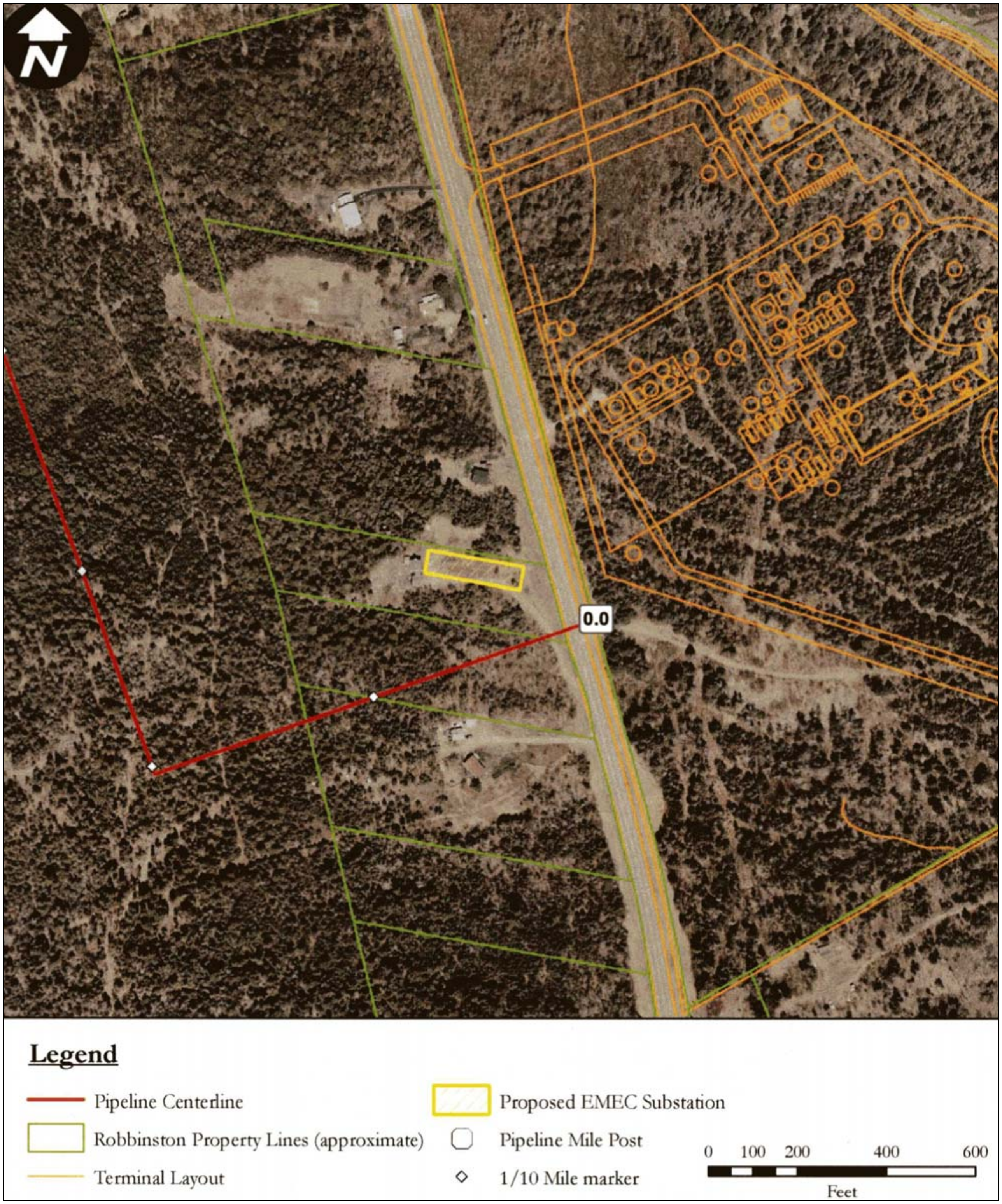

Figure I-5
Downeast LNG Project
EMEC Proposed Electric Substation

Appendix J

Regional Site Selection Study

Table J-1
Results of Regional Site Selection Study Conducted by Downeast LNG
(FERC Docket No. CP07-52-000)
LNG Import Terminal Candidate Sites – Maine

Site Number	1	2	3	4	5	6	7
Site Location	**Cannery**	**Gravel Pit**	**Mill Cove**	**Coastal**	**Gleason Cove**	**Estes Head**	**Quoddy Head**
Town	Robbinston	Robbinston	Robbinston	Perry	Perry	Eastport	Lubec
COMMUNITY ASSESSMENT (40% weight)							
Official Town Support	Yes	Yes	Yes	Questionable	Questionable	Possible	Possible
Residents' Position	Supportive	Supportive	Supportive	Generally supportive	Generally supportive	50/50 or less	> support possible
Land-use Status	Variance needed	Variance needed	Variance needed	Variance needed	Variance needed	Variance needed	No variance
Legal Control of Site	Pending	Pending	Pending	No-action	No-action	No	No-action
Status of Opposition	None in community	None in community	None in community	Against Quoddy	Against Quoddy	Likely	None
Position of Adjacent Communities	Generally supportive	Generally supportive	Generally supportive	Some opposition	Some opposition	Some opposition	None at present
Socioeconomic position	Job+growth focus	Job+growth focus	Job+growth focus	Job/env. Focus	Job/env. Focus	Job Focus	Job+growth focus
Impact on other activities	Minimal	Minimal	Minimal	Minimal	Minimal	Possible	Minimal
SCORE	**8**	**8**	**8**	**6**	**5**	**3**	**7**
MARINE ASSESSMENT (30% weight)							
Technical Issues (15%)							
Sufficient draft (min 38' MLW, ideal 45' MLW)	40 - 200 ft	40 - 800 ft	40 - 3,500 ft or less	40 - 400 ft	40 - 3,500 ft	60 MLW	40 - 1,500 ft
Current	Less than 1 knot	Less than 1 knot	1-5 knots	1 - 2 knots	+5 knots w/tide	Minimal	Minimal
Wave regime	None	None	None	None	None	None	Yes, protected
Shipping channel with sufficient breadth/length (400')	3/4 mile	1/2 mile	+3/4 mile	Several miles	3/4 mile	Yes	NA
Sufficient turning radius (2,000')	3/4 mile	3/4 mile	+3/4 mile	Several miles	3/4 mile	Yes	NA
Transit of bridges	No	No	No	No	No	No	No
Level of shipping traffic at site	Low	Low	Low	Low	Medium	Medium	Low
Security Issues - Ship Protection	Good	Good	Good	Good	Fair	Fair	Good
Security Issues - Tank Protection	Good	Good	Good	Good	Poor	Poor	Good
Port Restrictions - Affects	Low	Low	Low	Low	High	High	Low
SCORE	**9**	**6**	**6**	**9**	**3**	**9**	**6**

Table J-1 (Cont'd)

Site Number	1	2	3	4	5	6	7
Site Location	**Cannery**	**Gravel Pit**	**Mill Cove**	**Coastal**	**Gleason Cove**	**Estes Head**	**Quoddy Head**
Town	Robbinston	Robbinston	Robbinston	Perry	Perry	Eastport	Lubec
Environmental Issues (15%)							
Dredging to Depth	None required	None required	None required	None required	Possible	No	No
Dredging Affects on Bio Resources?	None	None	None	None	High	None	None
Dredge Spoil Contamination Possible?	None	None	None	None	High	None	None
Endangered species/habitat?	No	No	No	No	Yes	No	Maybe
Limited or no fishery activity including:							
Aquaculture leases	No	No	Yes, weir	No	Yes, weir	Yes	No
Lobster habitat	No	No	No	No	No	No	Some
Molluscan habitat	No	No	Possible	No	Yes	Yes	Some
Blood worm habitat	No	No	No	No	Yes	No	No
Limited or no presence of:							
Shorebird habitat	Periodic fly-by	Periodic fly-by	Possible	Periodic fly-by	Possible	Minimal	Some
Waterfowl habitat	Minimal	Minimal	Possible	Minimal	Possible	Minimal	Some
Sea mammal habitat (otters, seals and whales)	None	None	None	None	Yes - otters and seals	Yes	Yes
Aesthetics - View of Pier/Ship							
Degree of Visibility	Partially hidden	Partially hidden	Partially hidden	Visible	Very visible	Visible	Visible
Number of Potential Viewers	Limited	Limited	Limited	None	Very visible	High	High
Marine Use Compatibility							
With Existing Use?	Former Dock	No	No	No	No	Dock	No
With Future Use?	Compatible	Open Use	Open Use	Open Use	Open Use	Compatible	Open Use
With Surrounding Use?	Historical	No	No	No	No	No	No
Cultural Resources - Marine	Low	Low	Low-Medium	Low	Medium	Low	Low
SCORE	**8**	**8**	**7**	**8**	**2**	**7**	**7**

Table J-1 (Cont'd)

Site Number	1	2	3	4	5	6	7
Site Location	**Cannery**	**Gravel Pit**	**Mill Cove**	**Coastal**	**Gleason Cove**	**Estes Head**	**Quoddy Head**
Town	Robbinston	Robbinston	Robbinston	Perry	Perry	Eastport	Lubec
LAND ASSESSMENT (30% weight)							
Technical Issues (15%)							
Undeveloped land in the project vicinity – land sufficient to meet thermal and vapor exclusion zones	Yes: 4.5 acre parcel on coast - land in back available, but road crossing	Possible: 9 acres on coast - exclusion zone on adjacent property	Yes: 80 acres on coast - exclusion zone on property	Mixed parcels	45 acres on coast - exclusion zone may cover U.S. Route 1	15 acres - exclusion zone on nearby homes	Some available - 15 acres
Housing units within radius	Tank location no homes - homes near cyropipes	Yes - some buys	No	Possible	No	Yes	Homes nearby
Site availability – land available for purchase ideally with industrial zoning	Yes	Yes	Yes	Yes	Lease negotiation	NA	Yes
Existing infrastructure (Roads, Power, Water, etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Energy corridor commitment – distance to gas transmission lines	20 miles	20 miles	22 miles	30 miles	40 miles	45 miles	45 miles
Flood free zones	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SCORE	**3**	**6**	**8**	**7**	**7**	**3**	**4**
Environmental Issues (15%)							
Environmentally sensitive species	No	No	No	No	Yes	Yes	Possibly
Environmentally sensitive ecosystems	No	No	No	No	Yes	Yes	Possibly
Wetlands in vicinity of site	Exempt, small	No	No	No	Yes	No	No
Aesthetics - View of Tanks							
Existing landscape quality	Disturbed / Ind	Disturbed / Ind	Disturbed/ natural	Disturbed	Disturbed	Disturbed	Protected
Degree of Visibility	Low	Low	Low	Low	High	High	High
Number of Potential Viewers	Low	Low	Low	Low	High	High	High
Land Use Compatibility							
With Existing Use?	Yes	Yes	No	No	No	Yes	No
With Future Use?	Probably	Probably	Probably Not	Probably Not	No	Yes	Probably Not
With Surrounding Use?	No	Possibly	No	No	No	Yes	No
With Recreational Use?	Close proximity	No	Not apparent	No	Close proximity	Close proximity	Yes

Table J-1 (Cont'd)

Site Number	1	2	3	4	5	6	7
Site Location	**Cannery**	**Gravel Pit**	**Mill Cove**	**Coastal**	**Gleason Cove**	**Estes Head**	**Quoddy Head**
Town	Robbinston	Robbinston	Robbinston	Perry	Perry	Eastport	Lubec
Proximity to Large Population	No	No	No	No	Yes	Yes	Yes
Fill Requirements?	None	Isolated	None	Possible	None	None	None
Surface Water Resources	Drainage ditch	None	None	None	Pond	None	None
Unique/Harvested Vegetation	No	No	No	No	No	No	No
Cultural Resources - Land	None	None	Low	Low	Medium	High	None
Geotechnical Suitability	Good	Good	Good	Good	Unknown	Good	Good
Noise Sensitivity	Low	Low	Low	Low	High	High	Low
Site Contamination	Low-medium	Low-medium	Low	Low	Low	Low-medium	Low
SCORE	**5**	**7**	**7**	**5**	**5**	**6**	**5**
TOTAL SCORE	**Cannery**	**Gravel Pit**	**Mill Cove**	**Coastal**	**Gleason Cove**	**Estes Head**	**Quoddy Head**
Community	8	8	8	6	5	3	7
Marine	17	14	13	17	5	16	13
Land	8	13	15	12	12	9	9
Weighted Total Score (Max = 10)	**6.95**	**7.25**	**7.4**	**6.75**	**4.55**	**4.95**	**6.1**
Comparative Rank (n/27) =	**3**	**2**	**1**	**4**	**15**	**13**	**6**

Table J-1 (Cont'd)

Site Number	8	9	10	11	12	13	14
Site Location	**South Road**	**Bailey's Mistake**	**Navy Base**	**Navy Base**	**Sears Island**	**Mack Point**	**Navy Base**
Town	Lubec	Lubec	Cutler	Gouldsboro	Searsport	Searsport	Harpswell
COMMUNITY ASSESSMENT (40% weight)							
Official Town Support	Possible	Possible	Possible	None	None	None	None
Residents' Position	> support possible	> support possible	50/50	Majority against	50/50	50/50	50/50
Land-use Status	No variance	No variance	No variance	Variance needed	No variance	No variance	No variance
Legal Control of Site	No-action	No-action	Navy controlled site	Govt. controlled	Navy controlled site	Navy controlled site	Navy controlled site
Status of Opposition	None	None	Some against Quoddy	Against	Organized/active	Organized/active	Organized/active
Position of Adjacent Communities	None at present	None at present	None at present	Against	Against	Against	Against
Socioeconomic position	Job+growth focus	Job+growth focus	Job/growth/tourism	fishery/tourism	Fishery/tourism conflict	Fishery/tourism conflict	Fishery/tourism conflict
Impact on other activities	Minimal	Minimal	Minimal	Possible	Unknown	Unknown	Yes
SCORE	**7**	**6**	**5**	**2**	**2**	**5**	**3**
MARINE ASSESSMENT (30% weight)							
Technical Issues (15%)							
Sufficient draft (min 38' MLW, ideal 45' MLW)	40 - 500 ft	40 - 500 ft	40 - 700 ft	40 - 1,000 ft	40 - 500 ft	40 - 3,500 ft	40 - 700 ft
Current	Minimal	Minimal	Minimal	Yes	Minimal	Minimal	NA
Wave regime	Yes, protected	Yes, protected	Yes, protected	Yes	None	None	None
Shipping channel with sufficient breadth/length (400')	NA	NA	NA	NA	NA	NA	Yes
Sufficient turning radius (2,000')	NA	NA	NA	NA	NA	Restricted	Yes
Transit of bridges	No	No	No	No	No	No	No
Level of shipping traffic at site	Low	Low	Medium	Medium	High	High	Medium
Security Issues - Ship Protection	Good	Good	Good	Good	Good	Fair	Fair
Security Issues - Tank Protection	Good	Good	Fair	Fair	Good	Good	Good
Port Restrictions - Affects	Low	Low	Medium	Medium	Medium	Medium	Medium
SCORE	**8**	**8**	**9**	**4**	**9**	**4**	**7**

Table J-1 (Cont'd)

Site Number	8	9	10	11	12	13	14
Site Location	**South Road**	**Bailey's Mistake**	**Navy Base**	**Navy Base**	**Sears Island**	**Mack Point**	**Navy Base**
Town	Lubec	Lubec	Cutler	Gouldsboro	Searsport	Searsport	Harpswell
Environmental Issues (15%)							
Dredging to Depth	No	No	No	No	No	Required	No
Dredging Affects on Bio Resources?	None	None	None	None	None	High	None
Dredge Spoil Contamination Possible?	None	None	None	None	None	High	None
Endangered species/habitat?	No	No	No	No	Some	No	No
Limited or no fishery activity including:							
Aquaculture leases	No	No	No	No	No	No	No
Lobster habitat	Some	Some	Yes	Yes	Yes	Yes	Yes
Molluscan habitat	No	No	No	No	No	No	No
Blood worm habitat	No	No	No	No	No	No	No
Limited or no presence of:							
Shorebird habitat	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Waterfowl habitat	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Sea mammal habitat (otters, seals and whales)	Yes	Yes	No	Probably	Yes	Yes	Yes
Aesthetics - View of Pier/Ship							
Degree of Visibility	Partially hidden	Partially hidden	Visible	Visible	Visible	Visible	Visible
Number of Potential Viewers	Limited	Limited	Very visible	Visible	Very visible	Very visible	Very visible
Marine Use Compatibility							
With Existing Use?	No	No	Dock	Dock	No	Dock	Dock
With Future Use?	Open Use	Open Use	Compatible	Compatible	Open Use	Compatible	Compatible
With Surrounding Use?	No	No	Yes	Yes	No	Yes	No
Cultural Resources - Marine	Low	Low	Low	Low	Low	Low	Low
SCORE	**8**	**8**	**5**	**5**	**6**	**4**	**4**

Table J-1 (Cont'd)

Site Number	8	9	10	11	12	13	14
Site Location	**South Road**	**Bailey's Mistake**	**Navy Base**	**Navy Base**	**Sears Island**	**Mack Point**	**Navy Base**
LAND ASSESSMENT (30% weight)							
Technical Issues (15%)							
Undeveloped land in the project vicinity – land sufficient to meet thermal and vapor exclusion zones	Yes - possibly available	Yes - possibly available	Yes	Yes	Yes	Yes	Yes
Housing units within radius	No	No	No	No	No	No	No
Site availability – land available for purchase ideally with industrial zoning	No Indust	No Indust	Apparently no	No	No	Yes	No
Existing infrastructure (Roads, Power, Water, etc.)	Roads Only	Roads Only	Yes	Yes	Yes	Yes	Yes
Energy corridor commitment – distance to gas transmission lines	45 miles	45 miles	45 miles	>40 miles	14 miles	12 miles	20 miles
Flood free zones	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SCORE	**5**	**4**	**5**	**3**	**7**	**8**	**7**
Environmental Issues (15%)							
Environmentally sensitive species	Possibly	Possibly	Possibly	Yes	No	No	Yes
Environmentally sensitive ecosystems	Possibly	Possibly	Possibly	Yes	No	No	Yes
Wetlands in vicinity of site	Possibly	No	No	No	No	No	No
Aesthetics - View of Tanks							
Existing landscape quality	Disturbed/ natural	Disturbed/ natural	Disturbed	Disturbed	Disturbed/ natural	Disturbed	Disturbed
Degree of Visibility	Low	Low	Medium	Medium	Medium	Medium	Medium
Number of Potential Viewers	Low	Low	Medium	Low	High	Medium	Medium
Land Use Compatibility							
With Existing Use?	No	No	No	No	No	Yes	No
With Future Use?	Probable not	Probable not	Probable not	Probable not	Probable not	Yes	Probable
With Surrounding Use?	No	No	No	No	No	Yes	No
With Recreational Use?	No	No	Close proximity	Close proximity	Close proximity	Close proximity	Close proximity
Proximity to Large Population	No	No	No	No	No	No	No
Fill Requirements?	None	None	None	None	None	None	None

Table J-1 (Cont'd)

Site Number	8	9	10	11	12	13	14
Site Location	**South Road**	**Bailey's Mistake**	**Navy Base**	**Navy Base**	**Sears Island**	**Mack Point**	**Navy Base**
Town	Lubec	Lubec	Cutler	Gouldsboro	Searsport	Searsport	Harpswell
Surface Water Resources	No	None	None	None	None	None	None
Unique/Harvested Vegetation	No	No	No	No	No	No	No
Cultural Resources - Land	None	None	None	None	None	None	None
Geotechnical Suitability	Good	Good	Good	Good	Good	Good	Good
Noise Sensitivity	Low	Low	Low	Low	Medium	Medium	Medium
Site Contamination	Low	Low	Medium	Medium	Low-medium	Medium	Medium
SCORE	**4**	**4**	**6**	**3**	**7**	**8**	**5**
TOTAL SCORE	**South Road**	**Bailey's Mistake**	**Navy Base**	**Navy Base**	**Sears Island**	**Mack Point**	**Navy Base**
Community	7	6	5	2	2	5	3
Marine	16	16	14	9	15	8	11
Land	9	8	11	6	14	16	12
Weighted Total Score (Max = 10)	**6.55**	**6**	**5.75**	**3.05**	**5.15**	**5.6**	**4.65**
Comparative Rank (n/27) =	**5**	**7**	**9**	**24**	**11**	**10**	**14**

Table J-2
Results of Regional Site Selection Study Conducted by Downeast LNG
(FERC Docket No. CP07-52-000)
LNG Import Terminal Candidate Sites – Non-Maine

Site Number	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Site Location	**Off-shore (NE Gateway or Neptune)**	**Salem Harbor**	**Existing Distrigas**	**Harbor Islands**	**Quincy Harbor**	**Cape Cod Canal**	**Shell Refin. (Weaver's Cove Site)**
Town	Gloucester, MA	Salem, MA	Everett, MA	Boston, MA	Quincy, MA	Sagamore, MA	Fall River, MA
COMMUNITY ASSESSMENT (40% weight)							
Official Town Support	Growing Opposition	Harbor is DPA	Against	Unknown	NA	Unknown	Against
Residents' Position	Growing Opposition	Mixed	50/50	Unknown	+Against	Mixed, growing anti-windfarm	++Against lawsuit
Land-use Status	NA - offshore	Offshore OK	Existing	Govt. Cons. Trust	Mostly park	Unknown	None needed
Legal Control of Site	NA - offshore	offshore OK	Existing	Govt.	No	No	Yes
Status of Opposition	++Against	Industry opposed	++Against	Not developed	Not developed	Derivative of Wind Farm	Strong and growing
Position of Adjacent Communities	Assume NA	Not apparent	50/50	Unknown	Unknown	Mixed	++Against
Socioeconomic position	Fishery conflict	Fishery conflict	None	Tourism conflict	Possible conflict	Unknown	Minimal
Impact on other activities	Possible fishery	Possible fishery	Boston Harbor (Pipeline (PL)	Yes	Possible	Possible	Env. + recreation
SCORE	**7**	**4**	**5**	**3**	**5**	**5**	**1**
MARINE ASSESSMENT (30% weight)							
Technical Issues (15%)							
Sufficient draft (min 38' MLW, ideal 45' MLW)	NA	Not in harbor	40 - 500 ft	Yes	No	Yes	Dredging required
Current	+5 knots	Not specified	Not specified	Variable	+5 knots w/tide	Minimal	Minimal
Wave regime	High	High	None	Variable	None	Exposed	None
Shipping channel with sufficient breadth/length (400')	NA	No	1/2 mile	Yes	Yes	600 ft	400 ft Federal channel 7 miles
Sufficient turning radius (2,000')	NA	No	Yes	Yes	No	Only 600 ft	Minimal - must be expanded
Transit of bridges	No	No	Yes	No	No	No	3 bridges
Level of shipping traffic at site	NA	Not specified	Medium	Variable	Variable	Poor	Medium
Security Issues - Ship Protection	Fair	Fair	Fair	Fair	Variable	Poor	Fair
Security Issues - Tank Protection	NA	Fair	Fair	Fair	Variable	Poor	Fair
Port Restrictions - Affects	NA	High	High	Variable	Variable	High	Medium
SCORE	**5**	**3**	**5**	**7**	**5**	**4**	**1**

Table J-2 (Cont'd)

Site Number	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Site Location	**Off-shore (NE Gateway or Neptune)**	**Salem Harbor**	**Existing Distrigas**	**Harbor Islands**	**Quincy Harbor**	**Cape Cod Canal**	**Shell Refin. (Weaver's Cove Site)**
Town	Gloucester, MA	Salem, MA	Everett, MA	Boston, MA	Quincy, MA	Sagamore, MA	Fall River, MA
Environmental Issues (15%)							
Dredging to Depth	NA	Major for harbor	Required for pipeline	No	Required	No	Significant (2MM CY)
Dredging Affects on Bio Resources?	Possible high (Regas)	Possible high	Possible high	None	High	None	High
Dredge Spoil Contamination Possible?	None	Yes	Yes	None	High	None	High
Endangered species/habitat?	No	Unknown	Possible (PL)	Possible	Possible	Possible	No
Limited or no fishery activity including:							
Aquaculture leases	Yes - fisheries	No	No	Possible	Possible	Fishing	No
Lobster habitat	Yes	Yes	Possible (PL)	Possible	Possible	Yes	No
Molluscan habitat	Yes	Yes	Possible (PL)	Possible	No	Possible	No
Blood worm habitat	No	No	No	No	No	No	No
Limited or no presence of:							
Shorebird habitat	No	Probable no (Harbor)	Yes	Yes	Yes	Probable	Possible
Waterfowl habitat	Yes	Yes	Yes	Yes	Yes	Probable	Possible
Sea mammal habitat (otters, seals and whales)	Whales possible	Probably	Probably No	Probably	Probably	Ship transit through whale breeding grounds	No
Aesthetics - View of Pier/Ship							
Degree of Visibility	Visible	Visible	Very visible	Very visible	Very visible	Very visible	Very visible
Number of Potential Viewers	Very visible	Very visible	Very visible	Very visible	Very visible	Very visible	Very visible
Marine Use Compatibility							
With Existing Use?	No	No (DPA yes)	Dock	No	No	No	Dock
With Future Use?	Open Use	Open Use	Compatible	Open Use	Prob No	Open Use	Compatible
With Surrounding Use?	No	No (DPA yes)	Yes	No	No	No	Yes
Cultural Resources - Marine	Low	Low	Low	Variable	Variable	Low	Low
SCORE	**8**	**8**	**7**	**8**	**2**	**7**	**7**

Table J-2 (Cont'd)

Site Number	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Site Location	**Off-shore (NE Gateway or Neptune)**	**Salem Harbor**	**Existing Distrigas**	**Harbor Islands**	**Quincy Harbor**	**Cape Cod Canal**	**Shell Refin. (Weaver's Cove Site)**
Town	Gloucester, MA	Salem, MA	Everett, MA	Boston, MA	Quincy, MA	Sagamore, MA	Fall River, MA
LAND ASSESSMENT (30% weight)							
Technical Issues (15%)							
Undeveloped land in the project vicinity – land sufficient to meet thermal and vapor exclusion zones	Yes (offshore)	Yes (offshore)	No	Yes	No	Available but insufficient exclusion zone on land and channel	Available, 1000 ft exclusion zone extends over interstate highway
Housing units within radius	NA	Not at harbor	No	Variable	No	Dwellings within zone	Possible
Site availability – land available for purchase ideally with industrial zoning	NA	Probably	No	No	No	Yes	Yes
Existing infrastructure (Roads, Power, Water, etc.)	No	Yes	Yes	No	Yes	Yes	Yes
Energy corridor commitment – distance to gas transmission lines	12 miles	10 miles	12 miles	10 miles	Yes	35 miles	10 miles
Flood free zones	Hurricane	Hurricane	Yes	Yes	Yes	Yes	Yes
SCORE	**5**	**4**	**5**	**5**	**3**	**3**	**3**
Environmental Issues (15%)							
Environmentally sensitive species	Yes	Yes-offshore	Probably (PL)	Yes	Probable	Yes	Yes
Environmentally sensitive ecosystems	Yes	Yes-offshore	Probably (PL)	Yes	Probable	Yes	Yes
Wetlands in vicinity of site	Yes (delivery)	Disturbed DPA	No	Probable	Probable	No	Bordering project site
Aesthetics - View of Tanks							
Existing landscape quality	Disturbed/ natural	Disturbed/ natural	Disturbed/ natural	Variable	Variable	Disturbed/ natural	Disturbed
Degree of Visibility	Low	Medium	High	High	High	High	High
Number of Potential Viewers	Low	Medium	High	High	High	High	High
Land Use Compatibility							
With Existing Use?	No	No (DPA yes)	Yes	No	No	No	Yes
With Future Use?	Probable not	Probable not	Probable not	Probable not	Probable not	Probable not	Yes
With Surrounding Use?	No	No	No	No	No	No	Yes
With Recreational Use?	No	Close proximity	Close proximity	Close proximity	Close proximity	Close proximity	No
Proximity to Large Population	No	No	No	No	No	No	Yes
Fill Requirements?	None	None	None	None	None	None	None

Table J-2 (Cont'd)

Site Number	15	16	17	18	19	20	21
Site Location	**Off-shore (NE Gateway or Neptune)**	**Salem Harbor**	**Existing Distrigas**	**Harbor Islands**	**Quincy Harbor**	**Cape Cod Canal**	**Shell Refin. (Weaver's Cove Site)**
Town	Gloucester, MA	Salem, MA	Everett, MA	Boston, MA	Quincy, MA	Sagamore, MA	Fall River, MA
Surface Water Resources	Yes-Regas	Yes-Regas	None	None	None	None	None
Unique/Harvested Vegetation	No	No	No	No	No	No	No
Cultural Resources - Land	None	None	None	None	None	None	None
Geotechnical Suitability	Good	Good	Good	Good	Good	Good	Good
Noise Sensitivity	Low	High	Medium	High	High	Medium	High
Site Contamination	Low	Low-medium	Medium	Low-medium	Low	Low-medium	Medium
SCORE	**5**	**5**	**5**	**5**	**5**	**5**	**4**
TOTAL SCORE	**Off-shore**	**Harbor**	**Existing**	**Harbor Islands**	**Quincy Harbor**	**Cape Cod Channel**	**Shell Refinery**
Community	7	4	5	3	5	5	1
Marine	10	7	10	12	8	8	4
Land	10	9	10	10	8	8	7
Weighted Total Score (Max = 10)	**5.8**	**4**	**5**	**4.5**	**4.4**	**4.4**	**2.05**
Comparative Rank (n/27) =	8	21	12	16	18-T	18-T	25

Table J-2 (Cont'd)

Site Number	22	23	24	25	26	27
Site Location	**New London Harbor**	**New Haven Harbor**	**Quonset Point**	**Coal Plant**	**Existing Keyspan Facility**	**Fuel Oil Terminal**
Town	New London, CT	New Haven, CT	Quonset, RI	Brayton Point, RI	Providence, RI	East Providence, RI
COMMUNITY ASSESSMENT (40% weight)						
Official Town Support	Unknown	Unknown	Unknown	Against	Possible support + against	Unknown
Residents' Position	Mixed	Initial, against	Unknown	Against	Mixed	Unknown
Land-use Status	Unknown	Industrial	Unknown	Power/fuel storage	Existing tank	Existing fuel oil operation
Legal Control of Site	No	Possible	No, state owned	Bankruptcy	Yes	Unknown
Status of Opposition	Not developed	Developing	Unknown	Initial opposition	Initial opposition	Unknown
Position of Adjacent Communities	Unknown	Against	Unknown	Against	Impartial/ against	Possible against
Socioeconomic position	Unknown	Unknown	None	Minimal	Minimal	Unknown
Impact on other activities	Near nuclear submarine base	High	Unknown	Env. + power	Env. + recreation	Major rec path
SCORE	**5**	**5**	**5**	**3**	**5**	**4**
MARINE ASSESSMENT (30% weight)						
Technical Issues (15%)						
Sufficient draft (min 38' MLW, ideal 45' MLW)	Yes, existing	Yes - dredging required	Dredging required	Dredging required	Existing, limited ship size, dredging required	May require dredging
Current	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Wave regime	No	No	No	None	None	None
Shipping channel with sufficient breadth/length (400')	Yes	Yes	Yes	Yes	2,000 feet	5,000 feet
Sufficient turning radius (2,000')	No, turned in main harbor	Insufficient - dredging required	Insufficient - dredging required	Yes	Yes	Yes
Transit of bridges	No	No	1 bridge	1 bridge	1 bridge	1 bridge
Level of shipping traffic at site	Medium	Medium	Medium	Medium	Medium	Medium
Security Issues - Ship Protection	Fair	Fair	Fair	Fair	Fair	Poor, mitigation required
Security Issues - Tank Protection	Fair	Fair	Good	Good	Fair	Good
Port Restrictions - Affects	Medium	Medium	Medium	Medium	Medium	Medium
SCORE	**3**	**3**	**3**	**3**	**3**	**4**

Table J-2 (Cont'd)

Site Number	22	23	24	25	26	27
Site Location	**New London Harbor**	**New Haven Harbor**	**Quonset Point**	**Coal Plant**	**Existing Keyspan Facility**	**Fuel Oil Terminal**
Town	New London, CT	New Haven, CT	Quonset, RI	Brayton Point, RI	Providence, RI	East Providence, RI
Environmental Issues (15%)						
Dredging to Depth	Possibly at berth	Required	Significant (3MM CY)	Significant (3-4MM CY)	Required	Possible, limited
Dredging Affects on Bio Resources?	Low	High	High	High	High	None
Dredge Spoil Contamination Possible?	Possible	High	Possible	High	High	Low
Endangered species/habitat?	No	No	Possible	No	No	No
Limited or no fishery activity including:						
Aquaculture leases	Yes (+Fishing)	Yes (+Fishing)	Yes (+Fishing)	Fish Limitations	No	No
Lobster habitat	Yes	Yes	Yes	No	No	No
Molluscan habitat	Yes, closed	Yes, cultured	Yes, closed	No	No	No
Blood worm habitat	No	No	No	No	No	No
Limited or no presence of:						
Shorebird habitat	Possible	Probable	Probable	Unknown	Unknown	Probable no
Waterfowl habitat	Possible	Probable	Probable	Possible	Unknown	Probable not
Sea mammal habitat (otters, seals and whales)	Probable	No	Possible	No	No	No
Aesthetics - View of Pier/Ship						
Degree of Visibility	Very visible	Very visible	Very visible	Very visible	Very visible	Very visible
Number of Potential Viewers	Very visible	Very visible	Very visible	Very visible	Very visible	Very visible
Marine Use Compatibility						
With Existing Use?	Dock	Dock	Dock	Dock + power	Dock	Dock
With Future Use?	Compatible	Not compatible	Not compatible	Possible	Compatible	Compatible
With Surrounding Use?	Mixed	Yes	Yes, but airport	No	No	No
Cultural Resources - Marine	Low	Low	Low	Low	Low	Low
SCORE	**3**	**3**	**3**	**3**	**3**	**5**

Table J-2 (Cont'd)

Site Number	22	23	24	25	26	27
Site Location	**New London Harbor**	**New Haven Harbor**	**Quonset Point**	**Coal Plant**	**Existing Keyspan Facility**	**Fuel Oil Terminal**
Town	New London, CT	New Haven, CT	Quonset, RI	Brayton Point, RI	Providence, RI	East Providence, RI
LAND ASSESSMENT (30% weight)						
Technical Issues (15%)						
Undeveloped land in the project vicinity – land sufficient to meet thermal and vapor exclusion zones	Near airport and offices	Limited or no availability, near airport, parks etc	Yes	No existing uses	No	Yes
Housing units within radius	Dwellings within zone	Possible	Possible	Yes	Yes - some possibly	No
Site availability – land available for purchase ideally with industrial zoning	Possibly	No	Possibly	Not available	Not enough	No
Existing infrastructure (Roads, Power, Water, etc.)	Limited	Yes	Yes	Yes	Yes	Yes
Energy corridor commitment – distance to gas transmission lines	+30 miles	+20 miles	+35 miles	Existing connection to pipeline	12 miles	5 miles
Flood free zones	Yes	Yes	Yes	Yes	Yes	Yes
SCORE	**2**	**2**	**3**	**4**	**4**	**5**
Environmental Issues (15%)						
Environmentally sensitive species	Possible	Unknown	Unknown	No	Unknown	No
Environmentally sensitive ecosystems	Probable	Possible	Unknown	Possible	Unknown	No
Wetlands in vicinity of site	No	No	No	Yes	No	No
Aesthetics - View of Tanks						
Existing landscape quality	Disturbed	Disturbed	Disturbed	Disturbed	Disturbed	Disturbed
Degree of Visibility	High	High	High	High	High	High
Number of Potential Viewers	High	High	High	High	High	High
Land Use Compatibility						
With Existing Use?	Yes	No	No	Yes	Yes	Yes
With Future Use?	Probably	No	No	Yes	Yes	Yes
With Surrounding Use?	Mixed	Yes	Yes	Yes	No	No
With Recreational Use?	Close proximity	No	No	No	No	No
Proximity to Large Population	Yes	Yes	Yes	Mostly yes	Yes	Yes
Fill Requirements?	Yes	No	No	Yes	Yes	Yes

Table J-2 (Cont'd)

Site Number	22	23	24	25	26	27
Site Location	**New London Harbor**	**New Haven Harbor**	**Quonset Point**	**Coal Plant**	**Existing Keyspan Facility**	**Fuel Oil Terminal**
Town	New London, CT	New Haven, CT	Quonset, RI	Brayton Point, RI	Providence, RI	East Providence, RI
Surface Water Resources	None	None	None	None	None	None
Unique/Harvested Vegetation	No	No	No	No	No	No
Cultural Resources - Land	None	None	None	None	None	None
Geotechnical Suitability	Good	Good	Good	Good	Good	Good
Noise Sensitivity	Medium	Medium	Medium	Low	High	Medium
Site Contamination	Medium	Medium	Medium	Medium	Medium	Medium
SCORE	5	5	5	5	5	5
TOTAL SCORE	**New London Harbor**	**New Haven Harbor**	**Quonset Point**	**Coal Plant**	**Existing**	**Fuel Oil Terminal**
Community	5	5	5	3	5	4
Marine	6	6	6	6	6	9
Land	7	7	8	9	9	10
Weighted Total Score (Max = 10)	**3.95**	**3.95**	**4.1**	**3.45**	**4.25**	**4.45**
Comparative Rank (n/27) =	**22-T**	**22-T**	**20**	**23**	**19**	**17**

Appendix K

Sendout Pipeline Route Alternatives

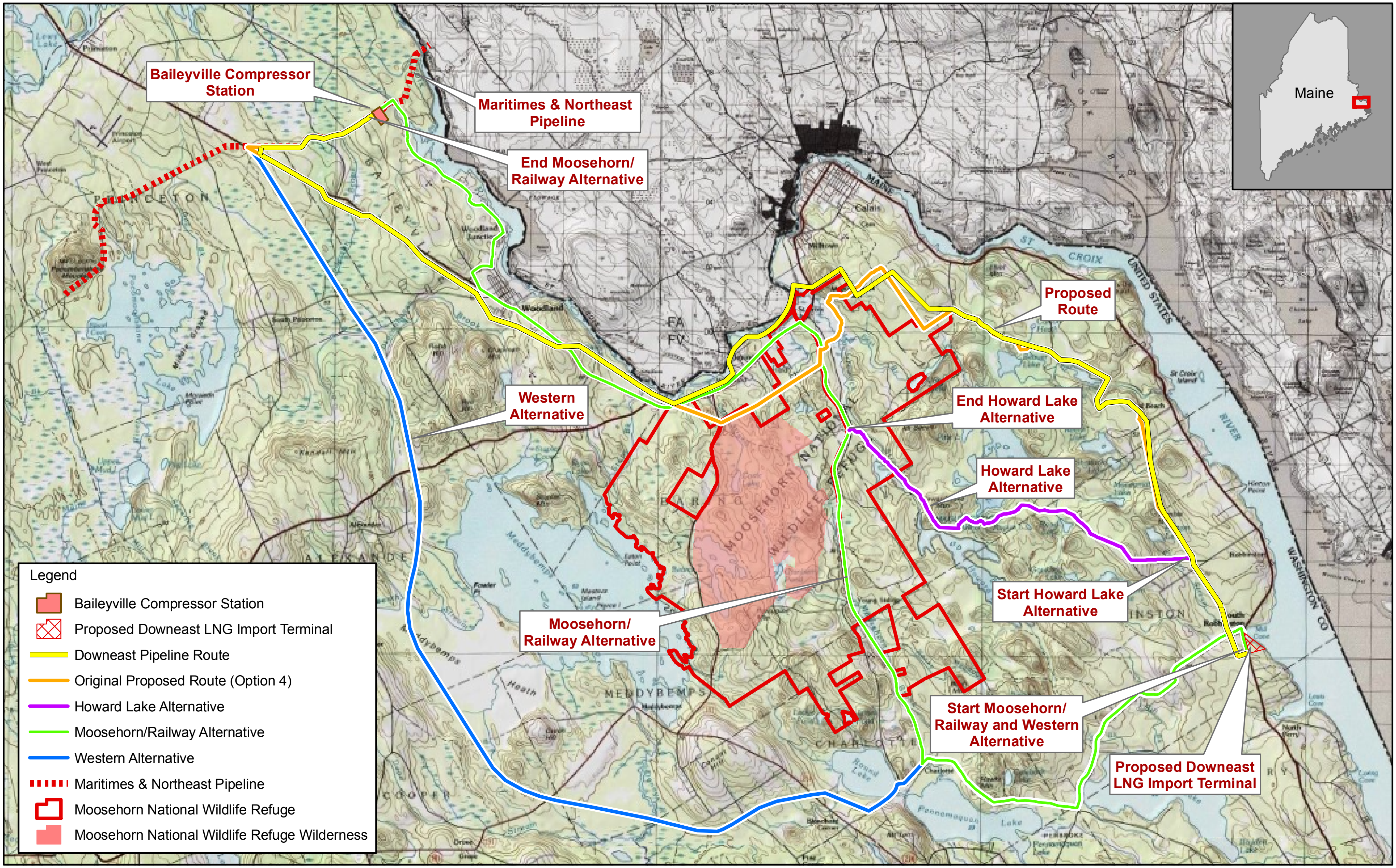

Figure K-1
Downeast LNG Project
Moosehorn Pipeline Route Alternatives

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Appendix L

Soil Types and Associated Limitations for the Sendout Pipeline

Appendix Table L-1

Soil Types and Associated Limitations for the Sendout Pipeline and Pipeline Components a/

Soil Type	Shallow Bedrock (< 60” bgs) (Yes/No)	Hydric Soil (Yes/No)	Poor or Very Poor Revegetation Potential for Grass/Herbaceous (Yes/No / Yes/No)	High Compaction Potential (Yes/No)	Prime Farmland (PF) or Farmland of Statewide Importance (SI) (PF/SI/No)	Potential Erodibility	Temporary Area Affected b/ (acres)	Permanent Area Affected c/ (acres)
Adams-Croghan association, 0 to 8 percent slopes	No	No	No / No	No	SI	Not highly erodible	1.73	0.58
Brayton-Colonel association, 0 to 8 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	8.88	4.94
Bucksport and Wonsqueak soils	No	Yes	Yes / Yes	Yes	No	Not highly erodible	2.35	1.23
Buxton silt loam, 8 to 15 percent slopes	Unknown	No	Unknown / Unknown	Unknown	SI	Potentially highly erodible	5.17	0.98
Chesuncook silt loam, 8 to 15 percent slopes	No	No	No / No	No	SI	Potentially highly erodible	2.85	1.72
Chesuncook-Elliottsville-Telos complex, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	4.34	2.29
Chesuncook-Telos association, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	3.79	2.03
Creasey gravelly silt loam, 3 to 8 percent slopes	Yes	No	No / No	No	SI	Not highly erodible	1.23	0.83
Creasey-Abram complex, 3 to 15 percent slopes	Yes	No	No / No	No	No	Potentially highly erodible	2.64	1.4
Creasey-Lamoine complex, 3 to 15 percent slopes	Yes	No	No / No	No	SI	Potentially highly erodible	3.61	1.87
Danforth-Elliottsville complex, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	3.26	2.12
Dixfield fine sandy loam, 8 to 15 percent slopes	Unknown	Unknown	Unknown / Unknown	Unknown	SI	Potentially highly erodible	0.07	0
Dixfield-Colonel complex, 3 to 8 percent slopes	No	No	No / No	No	PF	Not highly erodible	4.6	2.64
Dixfield-Colonel complex, 0 to 8 percent slopes, very stony	No	No	Yes / No	No	No	Not highly erodible	14.16	8.86
Dixfield-Marlow association, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	4.63	2.95
Dixfield-Marlow-Tunbridge complex, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	4.91	2.87
Dixfield-Rawsonville-Colonel complex, 3 to 15 percent slopes, very stony	Yes	No	Yes / No	Yes	No	Potentially highly erodible	2.56	1.61
Dixfield-Tunbridge-Colonel complex, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	14.63	8.35
Hermon-Monadnock-Skerry complex, 3 to 15 percent slopes, very bouldery	No	No	Yes / No	No	No	Potentially highly erodible	1.19	0.69
Hogback-Abram-Rawsonville complex, 15 to 60 percent slopes, very stony	Yes	No	Yes / Yes	No	No	Highly erodible	1.29	0.56
Hogback-Rawsonville-Abram complex, 3 to 15 percent slopes, very stony	Yes	No	Yes / Yes	No	No	Potentially highly erodible	3.31	1.82
Kinsman-Wonsqueak association, 0 to 3 percent slopes	No	Yes	No / No	Yes	No	Not highly erodible	0.14	0.09
Lamoine-Buxton complex, 0 to 8 percent slopes	No	No	No / No	Yes	SI	Not highly erodible	11.47	4.3

Appendix Table L-1

Soil Types and Associated Limitations for the Sendout Pipeline and Pipeline Components a/

Soil Type	Shallow Bedrock (< 60" bgs) (Yes/No)	Hydric Soil (Yes/No)	Poor or Very Poor Revegetation Potential for Grass/Herbaceous (Yes/No / Yes/No)	High Compaction Potential (Yes/No)	Prime Farmland (PF) or Farmland of Statewide Importance (SI) (PF/SI/No)	Potential Erodibility	Temporary Area Affected b/ (acres)	Permanent Area Affected c/ (acres)
Lamoine-Buxton-Scantic complex, 0 to 15 percent slopes	No	Yes	No / No	Yes	SI	Potentially highly erodible	8.76	4.7
Lamoine-Creasey-Scantic complex, 0 to 8 percent slopes	Yes	Yes	No / No	Yes	SI	Not highly erodible	2.47	1.32
Lamoine-Rawsonville-Scantic complex, 0 to 8 percent slopes, very stony	No	Yes	Yes / No	No	No	Not highly erodible	1.55	0.7
Lamoine-Scantic complex, 0 to 5 percent slopes	No	Yes	No / No	Yes	SI	Not highly erodible	14.81	4.91
Lamoine-Scantic complex, 0 to 5 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	0.31	0.15
Lamoine-Scantic-Colonel complex, 0 to 8 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	4.64	2.71
Lamoine-Tunbridge-Scantic complex, 0 to 8 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	1.21	0.6
Lyman-Abram-Tunbridge complex, 15 to 60 percent slopes, very stony	Yes	No	Yes / No	No	No	Highly erodible	1.71	1.11
Lyman-Tunbridge-Abram complex, 3 to 15 percent slopes, very stony	Yes	No	Yes / No	No	No	Potentially highly erodible	36.64	20.77
Marlow fine sandy loam, 8 to 15 percent slopes	Unknown	No	Unknown / Unknown	Unknown	SI	Potentially highly erodible	0.8	0.5
Marlow-Dixfield association, 8 to 30 percent slopes, very stony	No	No	No / No	No	No	Highly erodible	2.56	1.64
Masardis-Sheepscot complex, 0 to 15 percent slopes	No	No	No / No	No	SI	Potentially highly erodible	1.05	0.64
Monarda-Telos association, 0 to 8 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	9.21	5.16
Monarda-Wonsqueak complex, 0 to 5 percent slopes, very stony	No	Yes	Yes / No	Yes	No	Not highly erodible	2.37	1.39
Naskeag-Abram-Ricker complex, 0 to 15 percent slopes, very stony	Yes	Yes	Yes / No	Yes	No	Potentially highly erodible	5.42	3.3
Naskeag-Rawsonville-Hogback complex, 0 to 8 percent slopes, very stony	Yes	Yes	Yes / No	Yes	No	Potentially highly erodible	3.38	1.9
Naskeag-Tunbridge-Lyman complex, 0 to 8 percent slopes, very stony	Yes	Yes	Yes / No	Yes	No	Potentially highly erodible	4.83	2.79
Pits, sand and gravel	Unknown	No	NA / NA	No	No	Not highly erodible	1.32	0.41
Rawsonville-Lamoine-Hogback complex, 0 to 15 percent slopes, very stony	Yes	Yes	Yes / No	Yes	No	Potentially highly erodible	1.01	0.64
Scantic silt loam	No	Yes	No / No	Yes	No	Not highly erodible	2.85	1.25
Scantic-Biddeford association, 0 to 3 percent slopes	No	Yes	No / No	Yes	No	Not highly erodible	1.35	0.64
Skerry-Becket association, 3 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	3.72	2.19

Appendix Table L-1

Soil Types and Associated Limitations for the Sendout Pipeline and Pipeline Components a/

Soil Type	Shallow Bedrock (< 60" bgs) (Yes/No)	Hydric Soil (Yes/No)	Poor or Very Poor Revegetation Potential for Grass/Herbaceous (Yes/No / Yes/No)	High Compaction Potential (Yes/No)	Prime Farmland (PF) or Farmland of Statewide Importance (SI) (PF/SI/No)	Potential Erodibility	Temporary Area Affected b/ (acres)	Permanent Area Affected c/ (acres)
Skerry-Colonel-Rawsonville complex, 0 to 15 percent slopes, very stony	Yes	No	Unknown / Unknown	Unknown	No	Potentially highly erodible	2.88	1.75
Skerry-Colonel-Tunbridge complex, 0 to 15 percent slopes, very stony	No	No	Yes / No	No	No	Potentially highly erodible	4.5	1.78
Telos silt loam, 3 to 8 percent slopes	No	No	No / No	Yes	SI	Not highly erodible	3.26	1.57
Telos-Chesuncook complex, 0 to 8 percent slopes, very stony	No	No	Yes / No	Yes	No	Not highly erodible	15.34	8.1
Tunbridge-Lyman complex, 3 to 8 percent slopes	Yes	No	No / No	No	PF	Not highly erodible	3.52	2.14
Tunbridge-Lyman complex, 8 to 15 percent slopes	Yes	No	No / No	No	SI	Potentially highly erodible	0.79	0.47
Udorthents-Urban land complex	Unknown	No	NA / NA	No	No	Not highly erodible	0.91	0.49
Wonsqueak and Bucksport soils, frequently flooded	No	Yes	Yes / Yes	Yes	No	Not highly erodible	3.27	1.64
Total of All Soil Types d/							*249.25*	*132.09*

NA = Not applicable

a/ Pipeline components include: Additional Temporary Work Spaces (ATWS), ATWS Horizontal Directional Drill (HDD) Pads, Laydown Areas, one new access road (at MP 15.4), pipe storage areas, and one mainline valve site (at MP 17.2)

b/ Temporary area includes cleared areas of the construction right-of-way and aboveground facilities that would be cleared during the construction of the Project.

c/ Permanent area is a subset of Temporary area, and includes only those areas that will be permanently maintained for Project Operations.

d/ These totals do not include 9.5 acres (temporary and permanent) of additional access roads that would not impact native soils.

Source: USDA 2006a.

Appendix M

Significant Wildlife Habitat

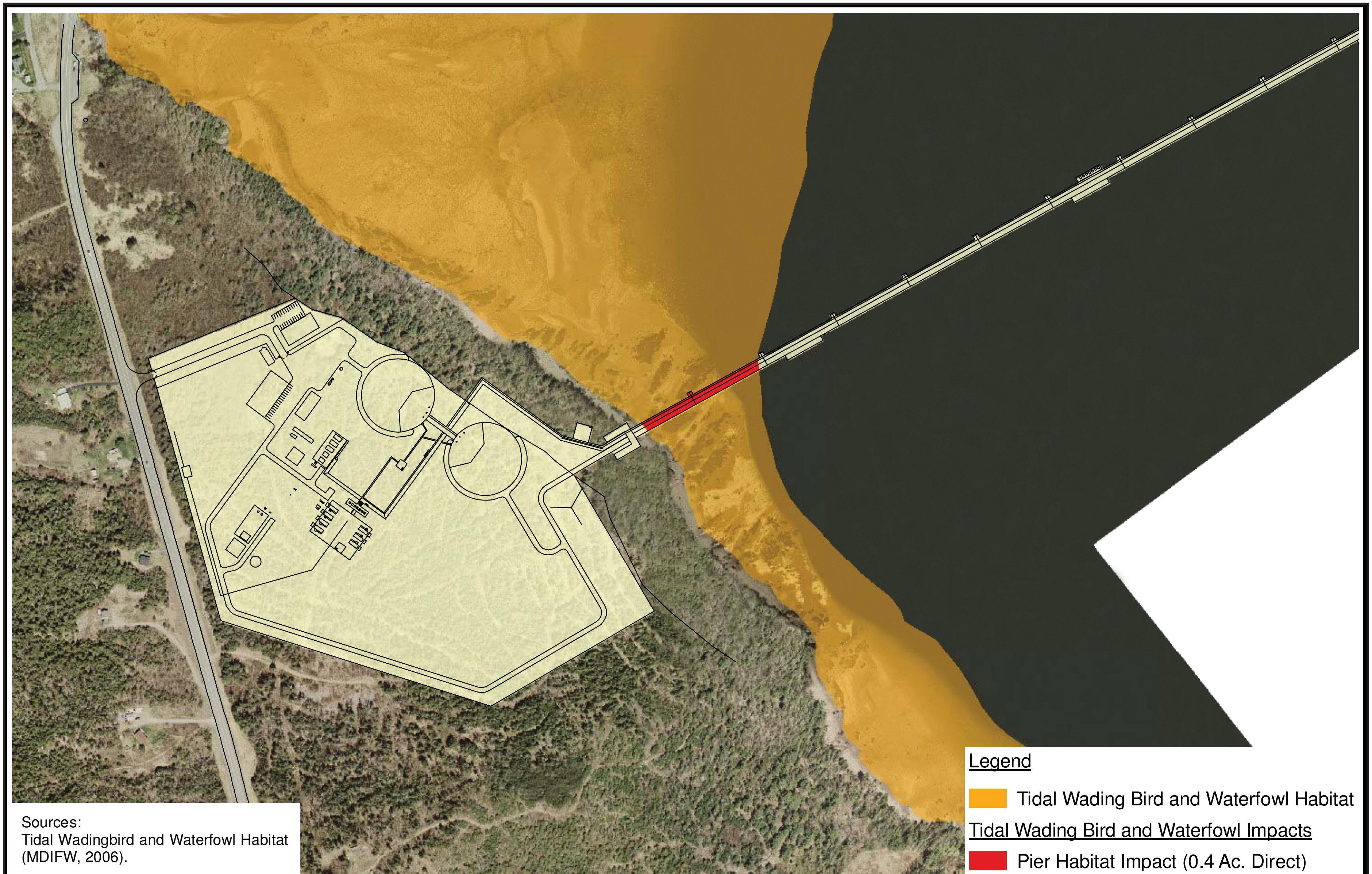

Figure M-1
Downeast LNG Project
Tidal Waterfowl and Wading Bird Habitat Impacts at the Proposed Downeast Import Terminal

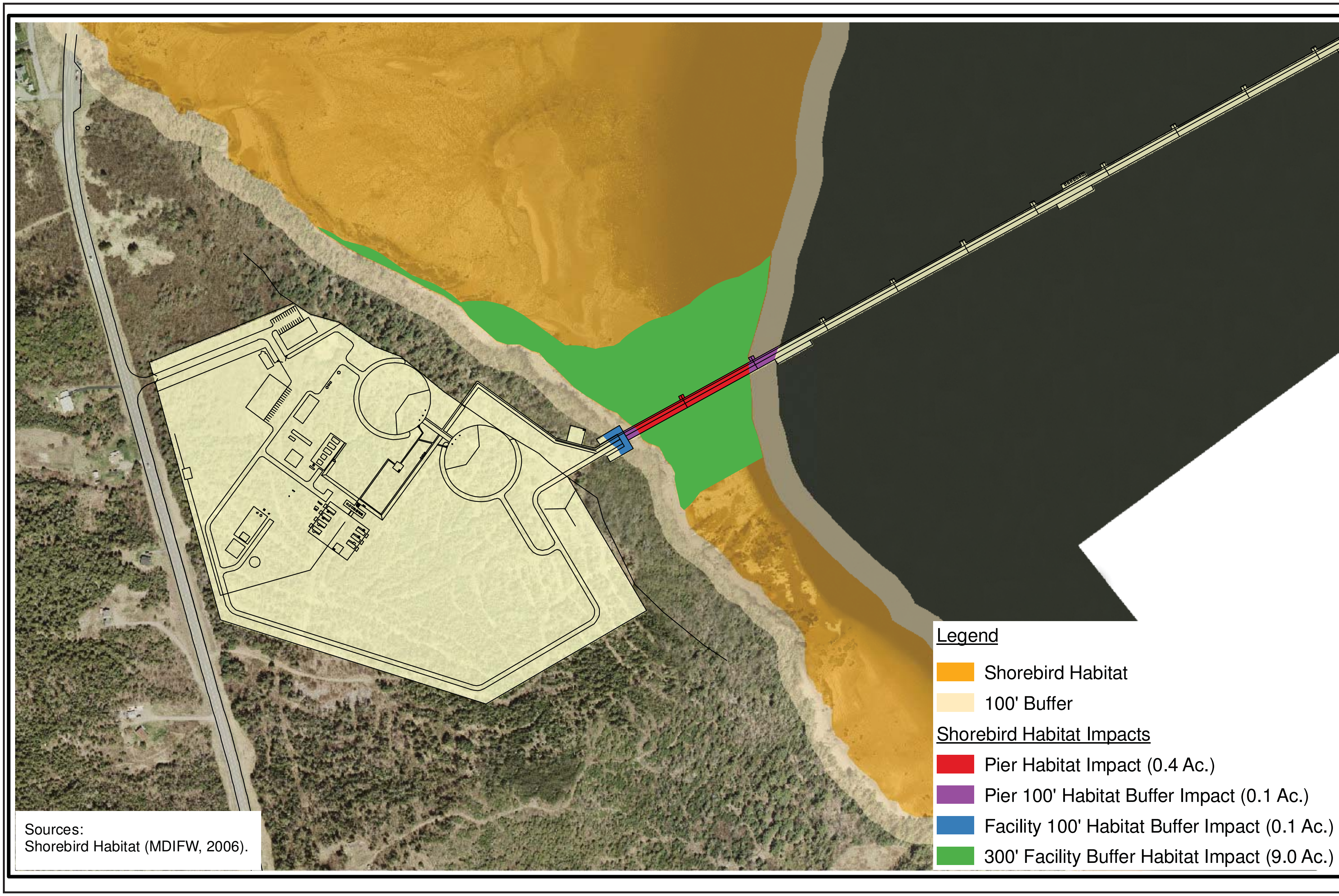

Figure M-2
Downeast LNG Project
Shorebird Habitat Impacts at the Proposed Downeast Import Terminal

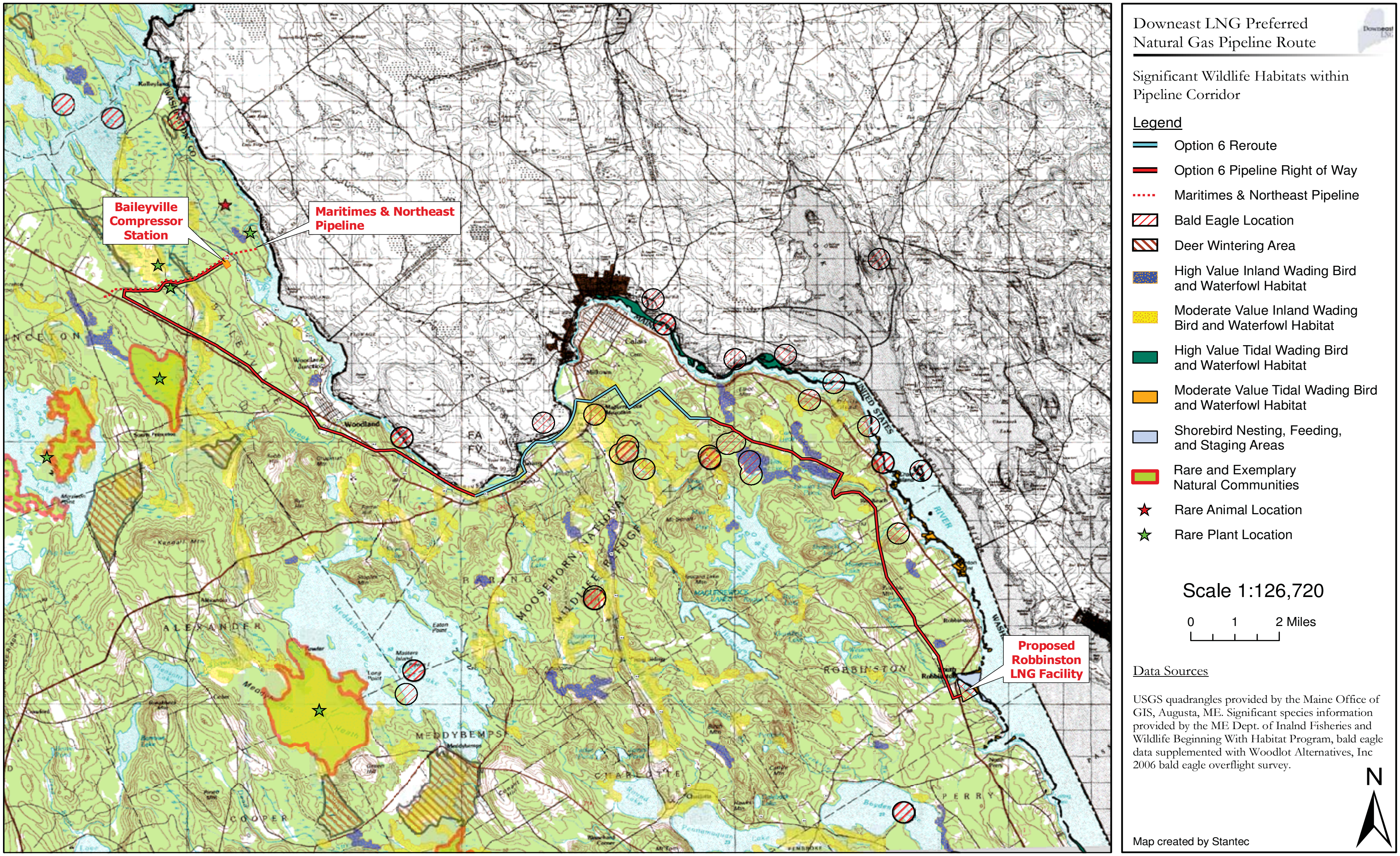

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Figure M-3
Downeast LNG Project
Significant Wildlife Habitats

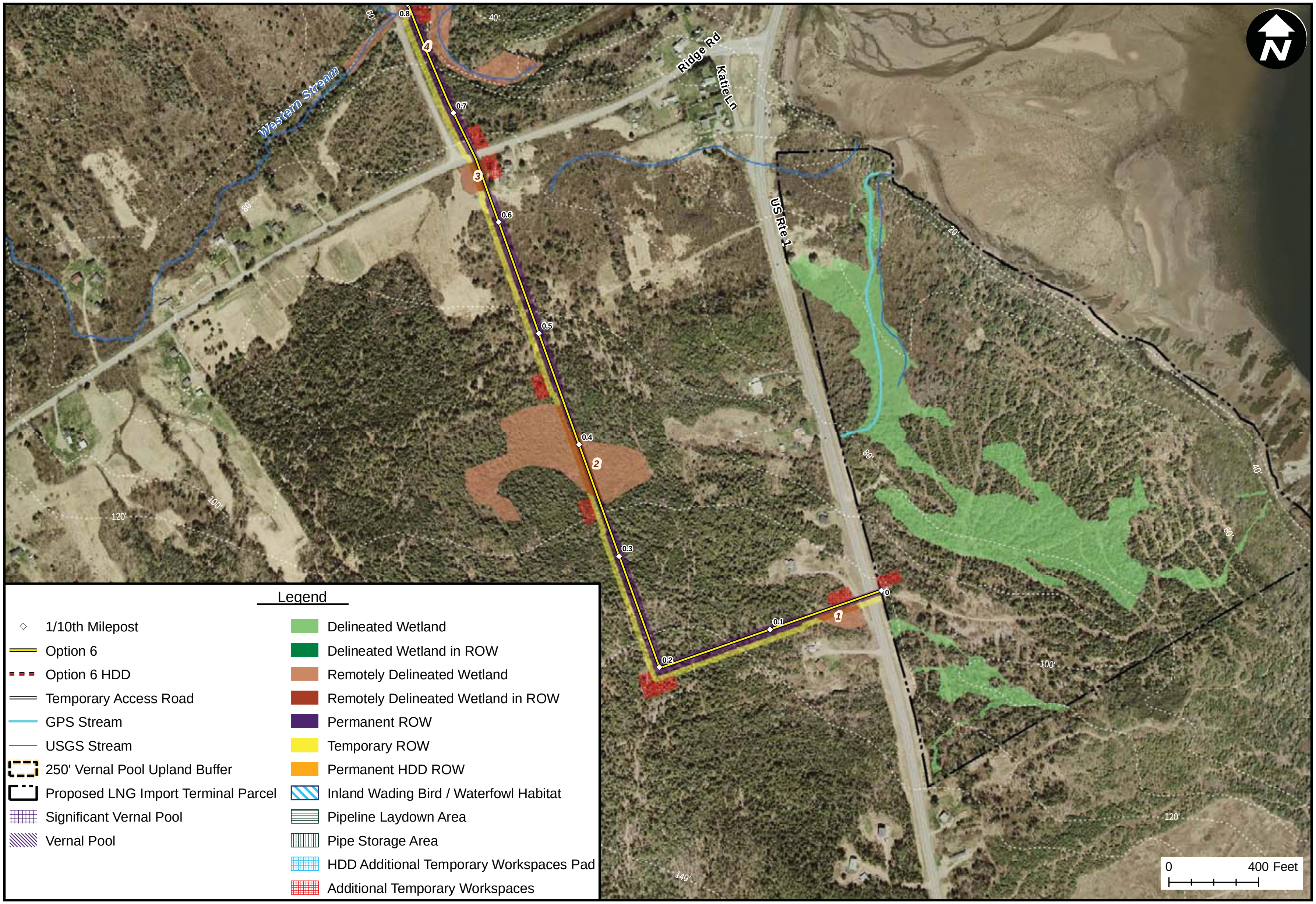

Figure M-4
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

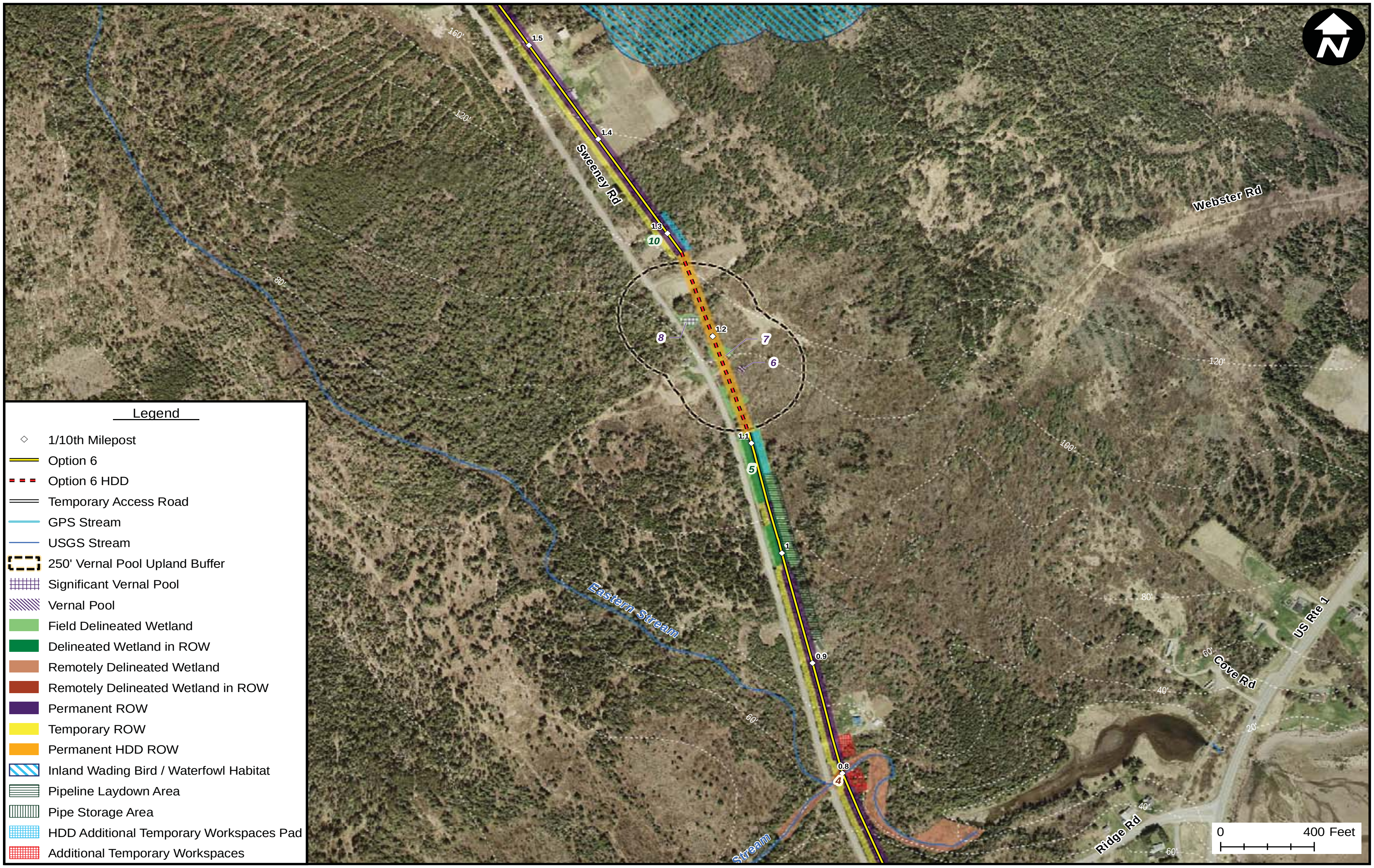

Figure M-5
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

Figure M-6
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

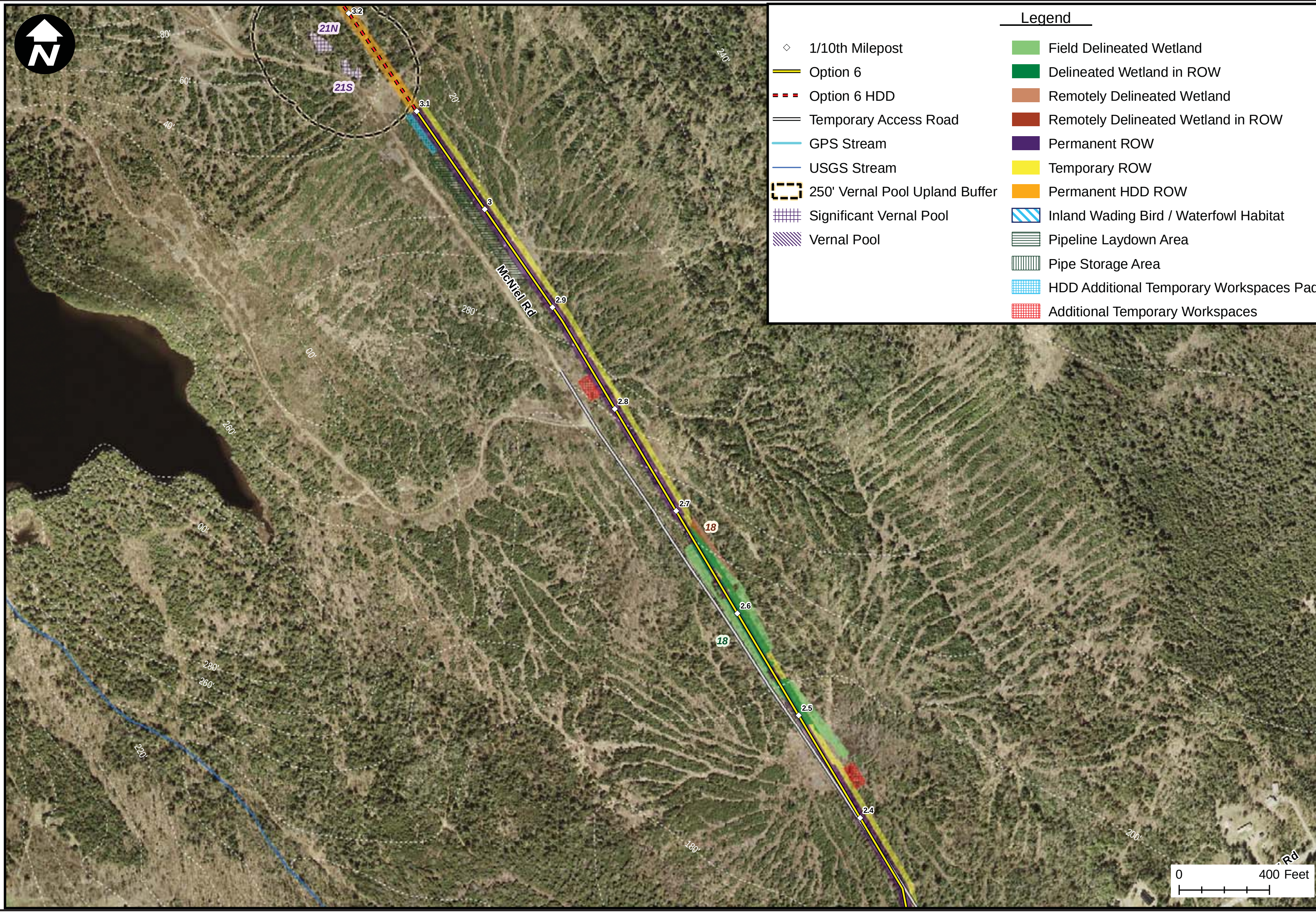

Figure M-7
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

Figure M-8
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

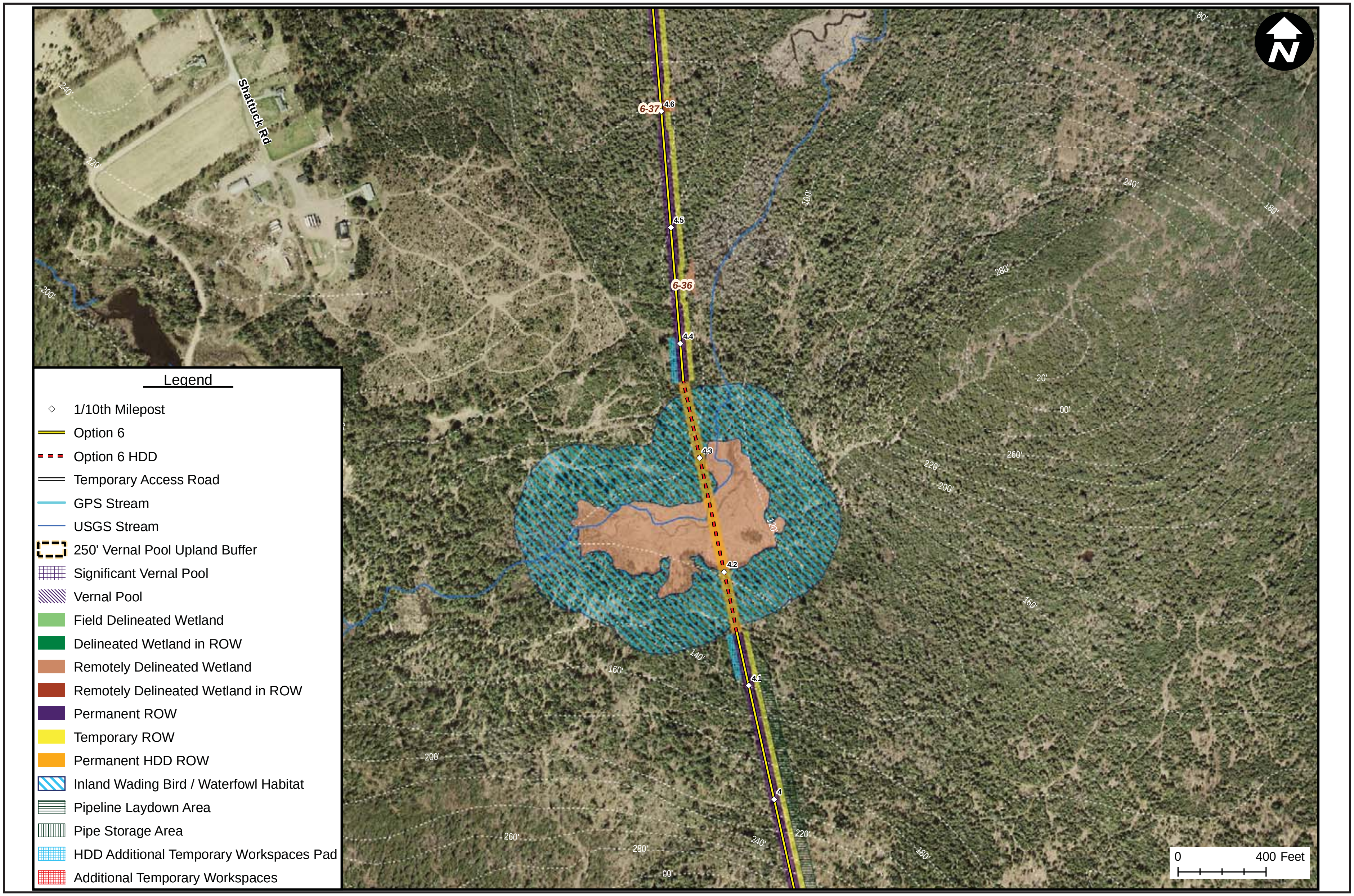

Figure M-9
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

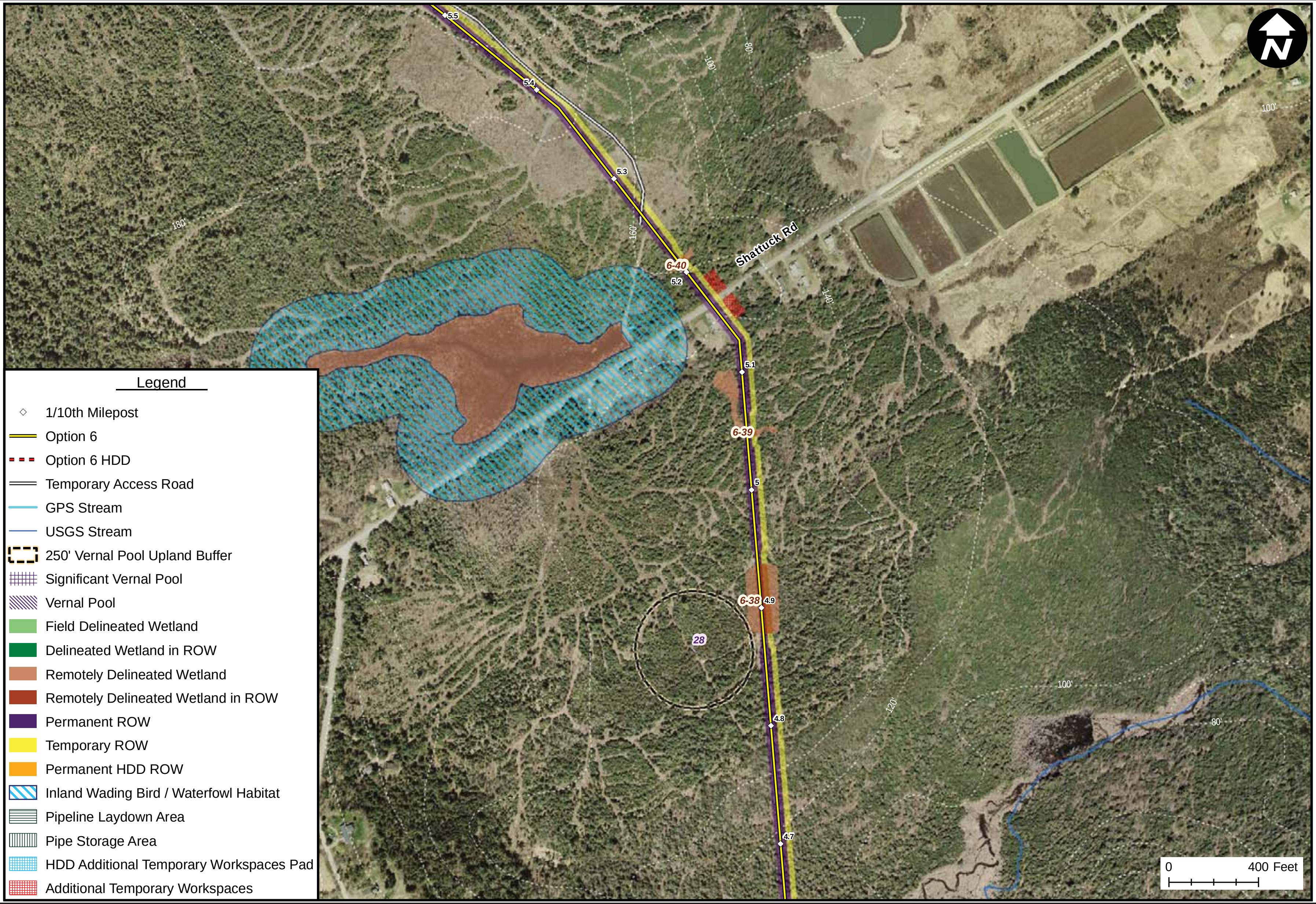

Figure M-10
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

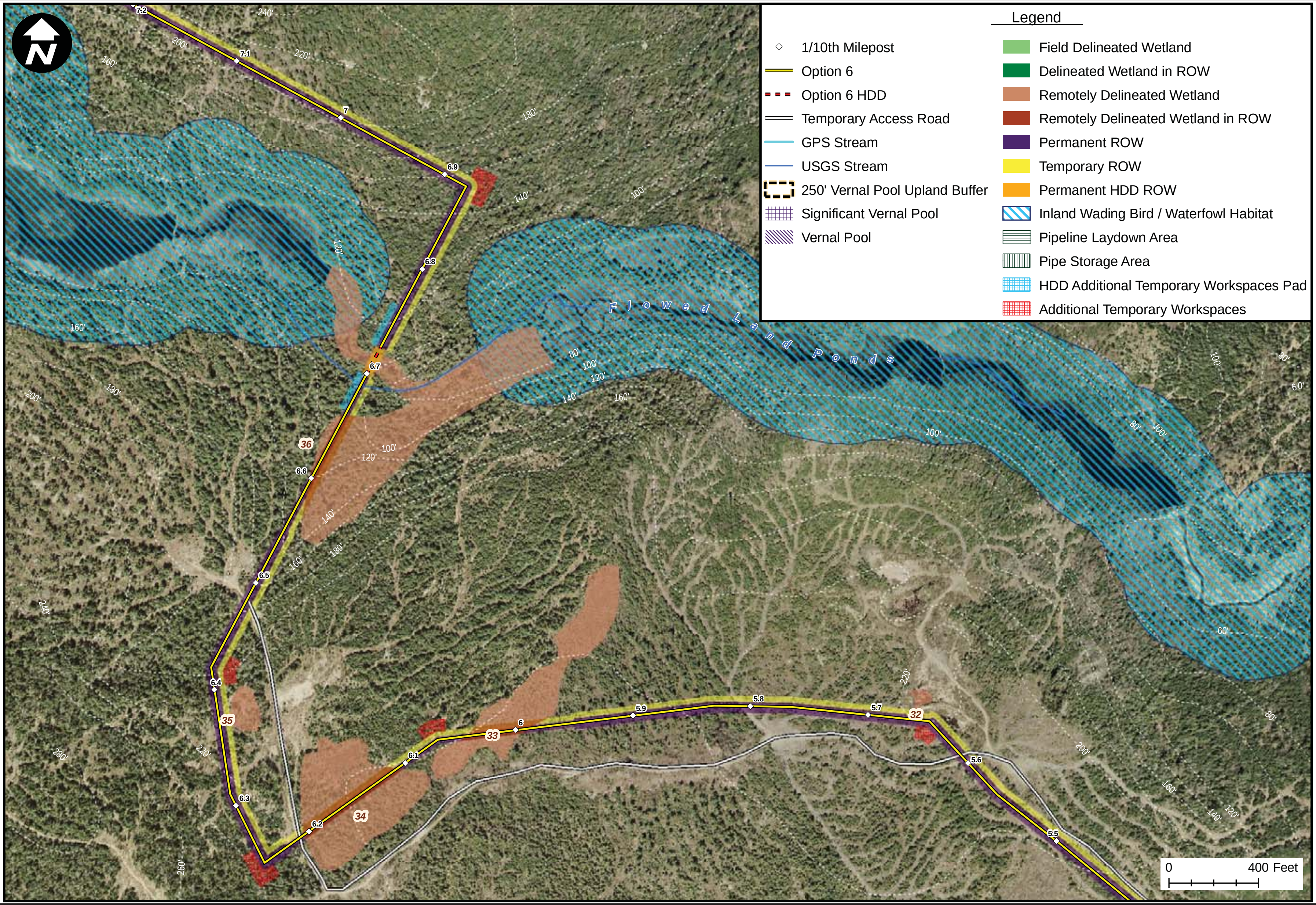

Figure M-11
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

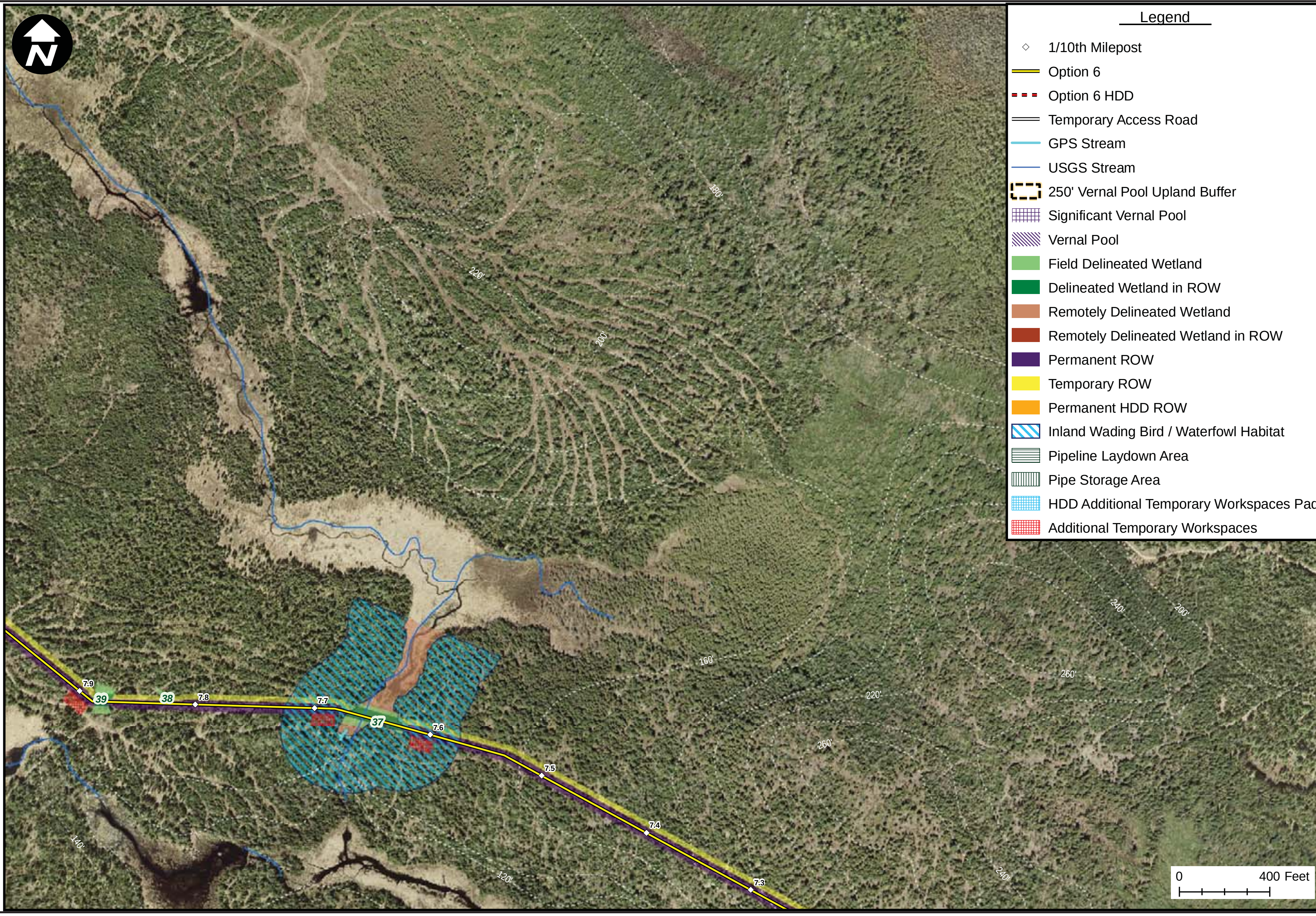

Figure M-12
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

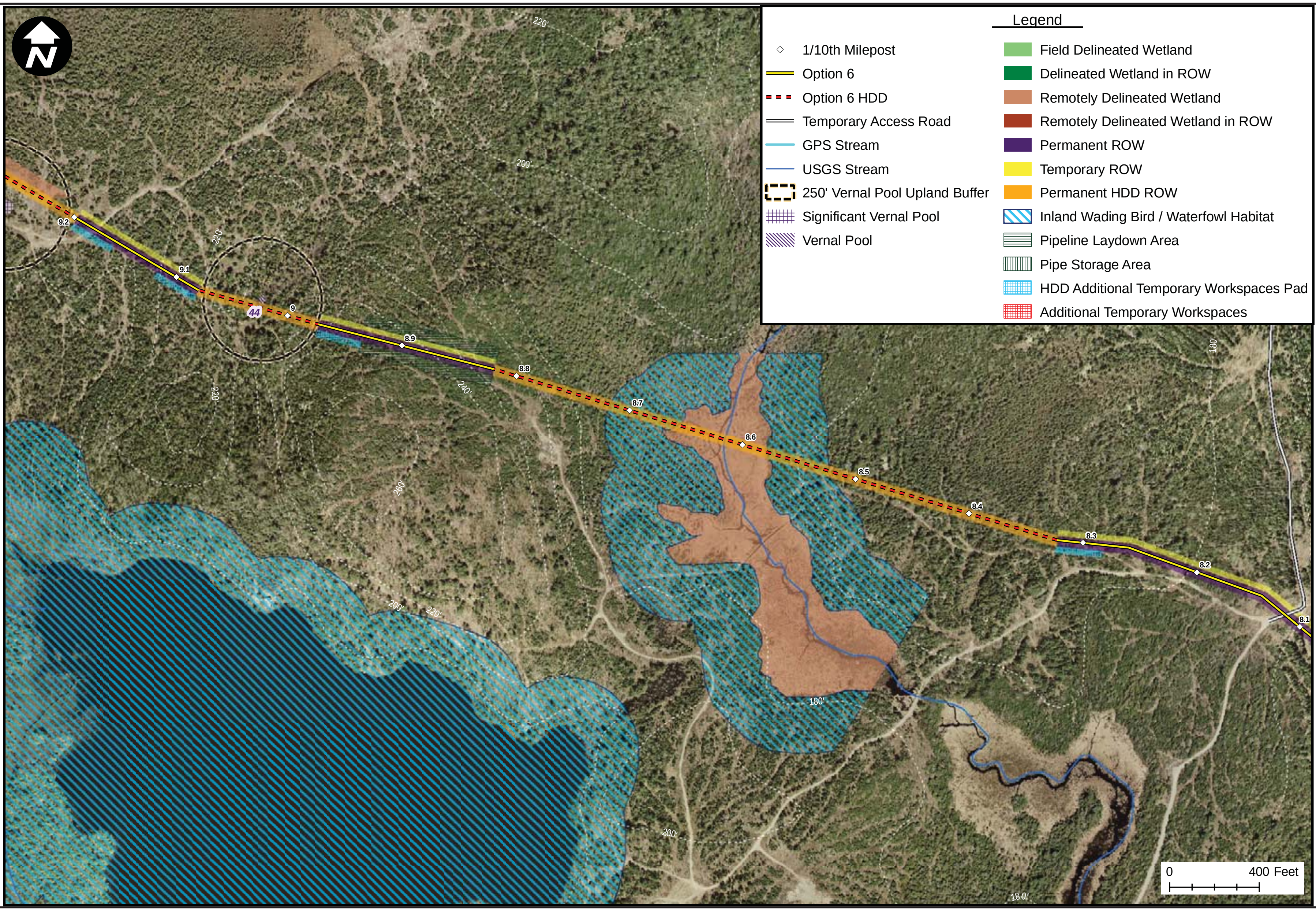

Figure M-13
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

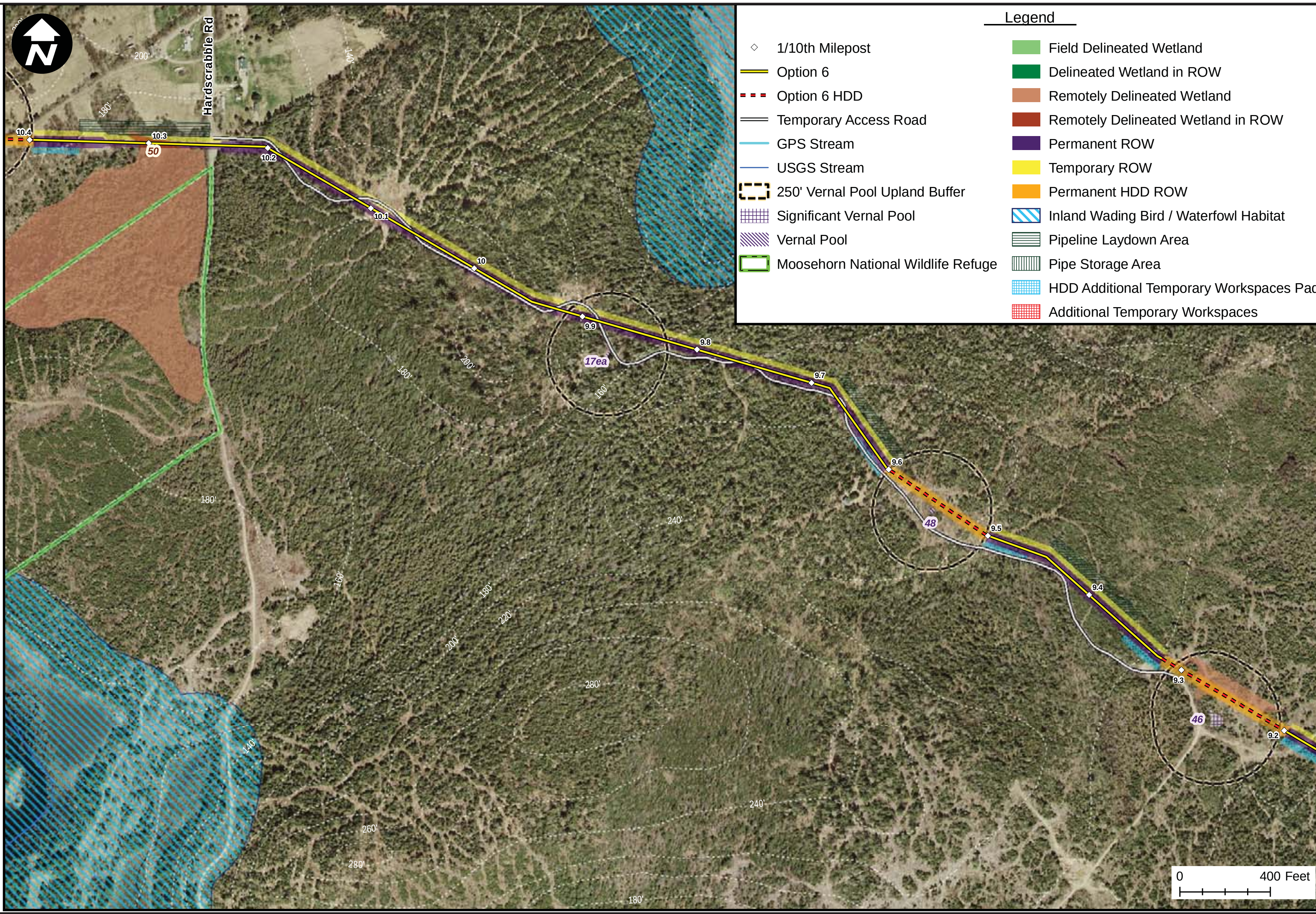

Figure M-14
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

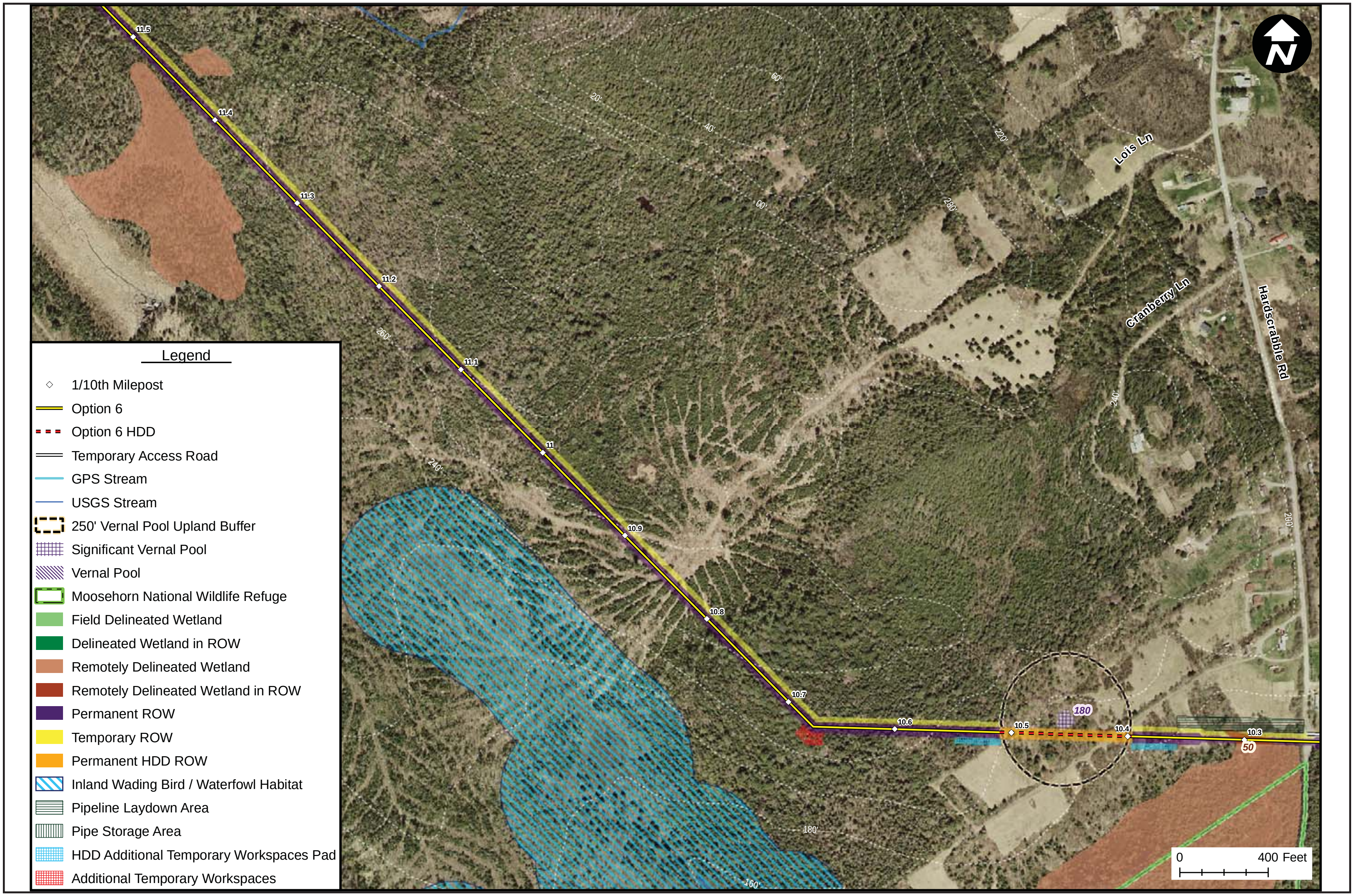

Figure M-15
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

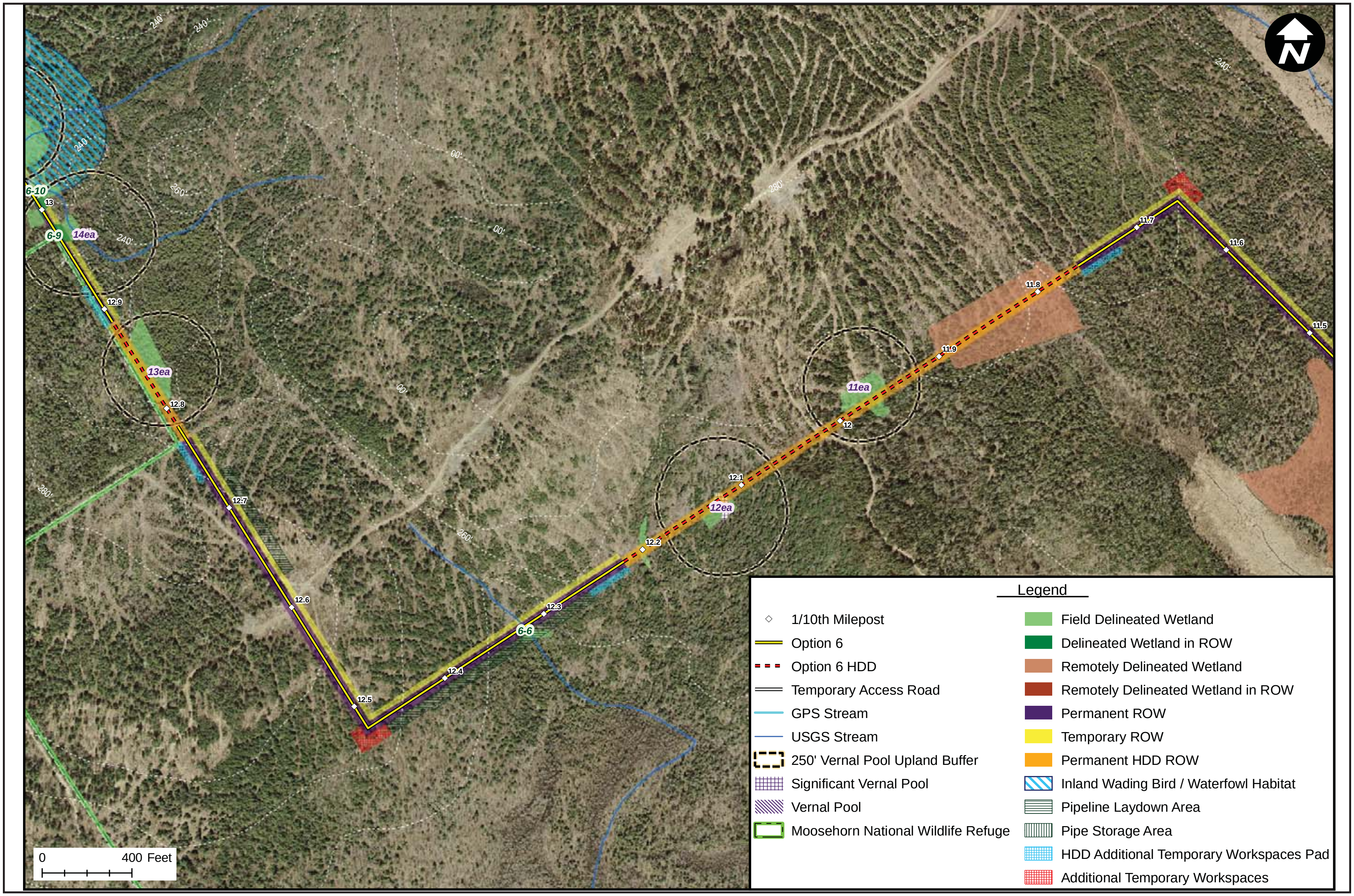

Figure M-16
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

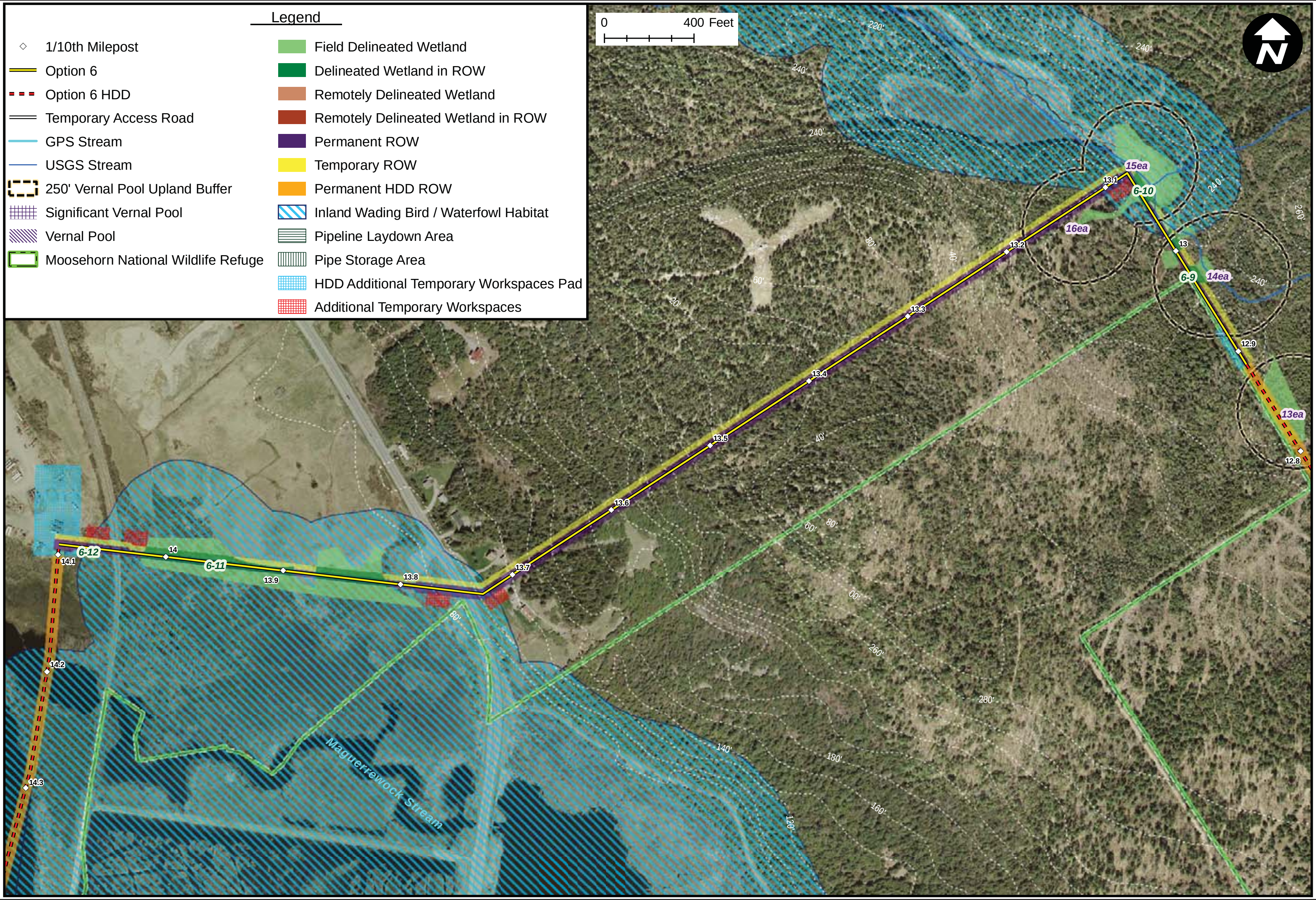

Figure M-17
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

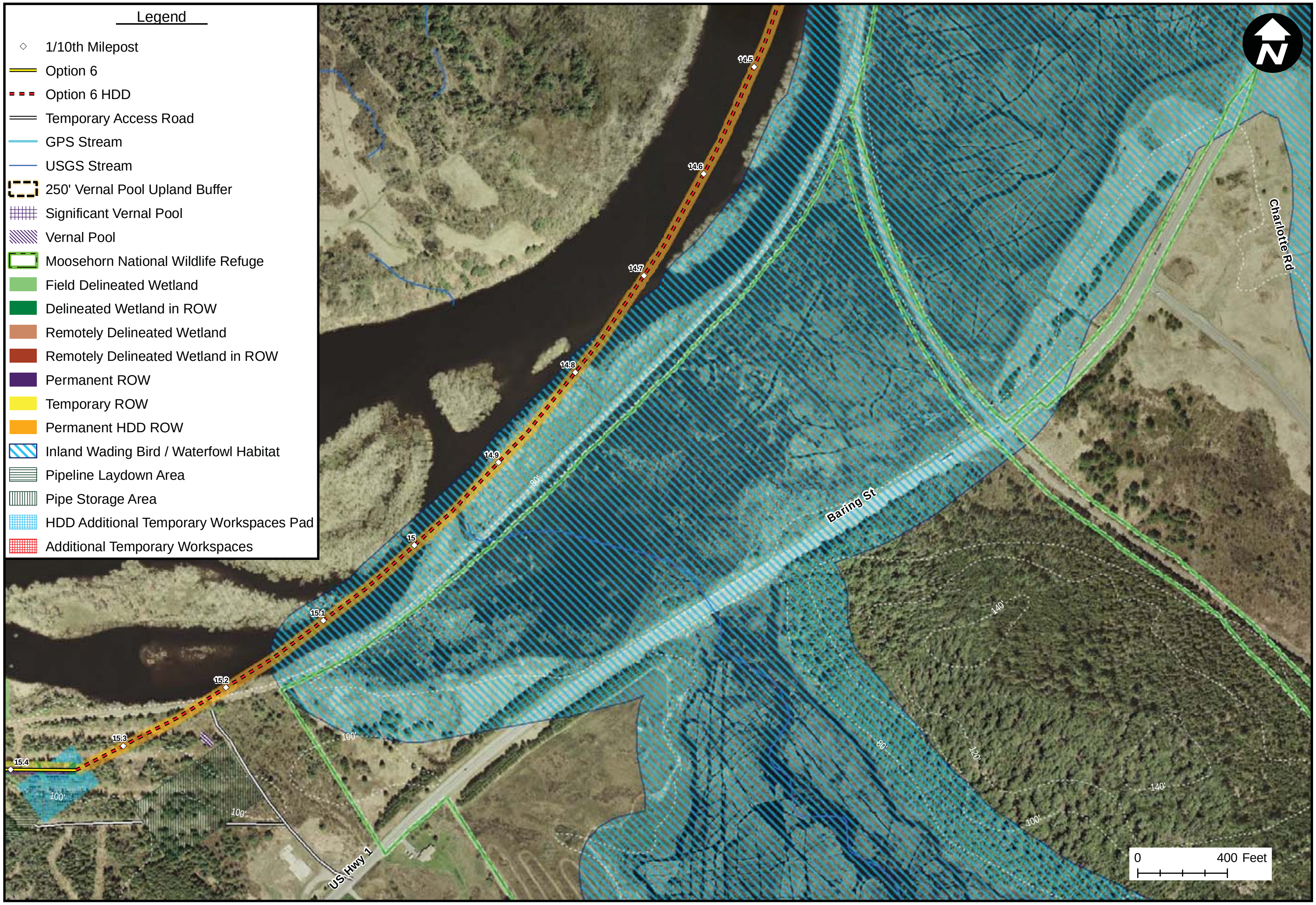

Figure M-18
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

Figure M-19
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

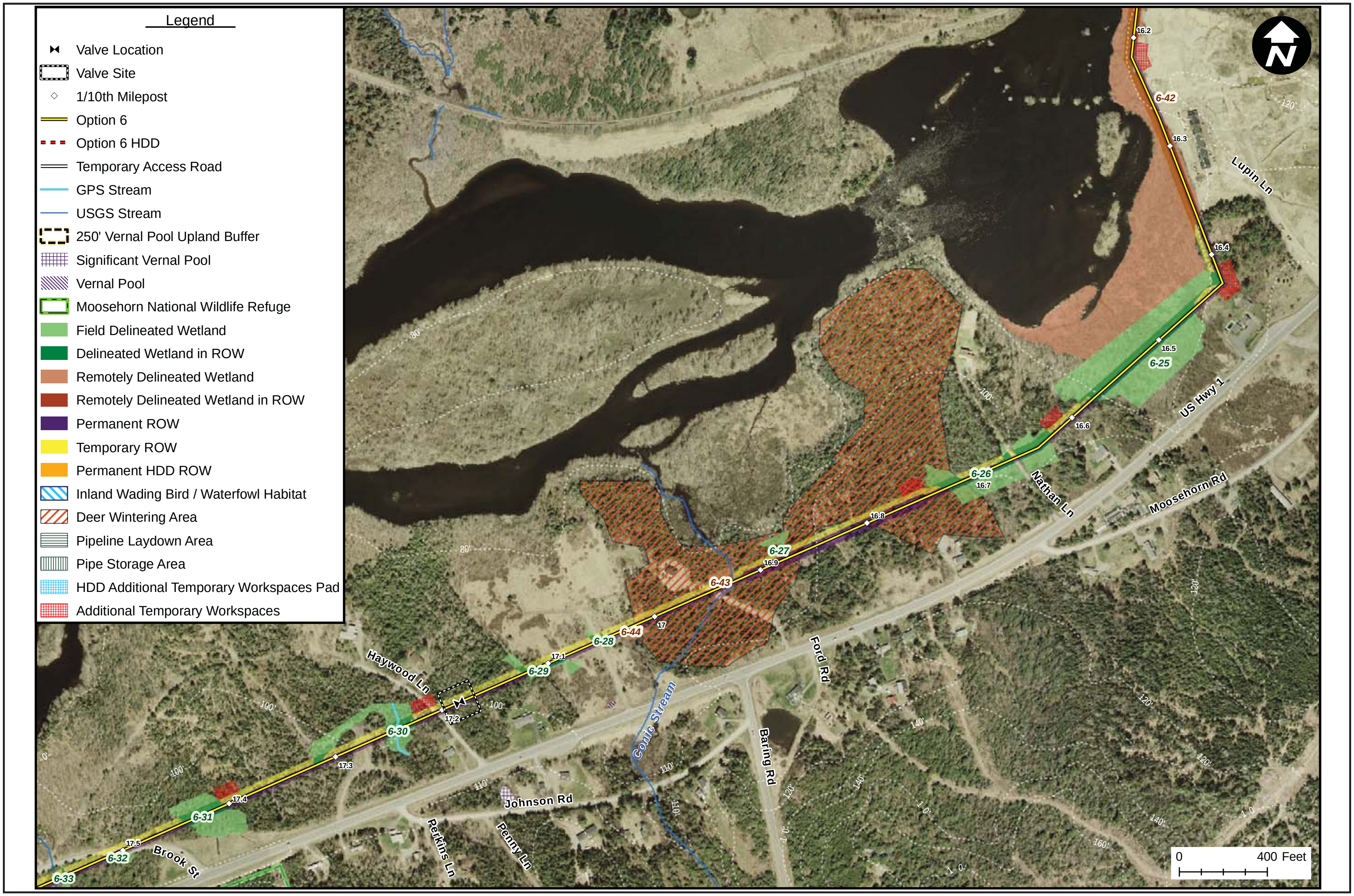

Figure M-20
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

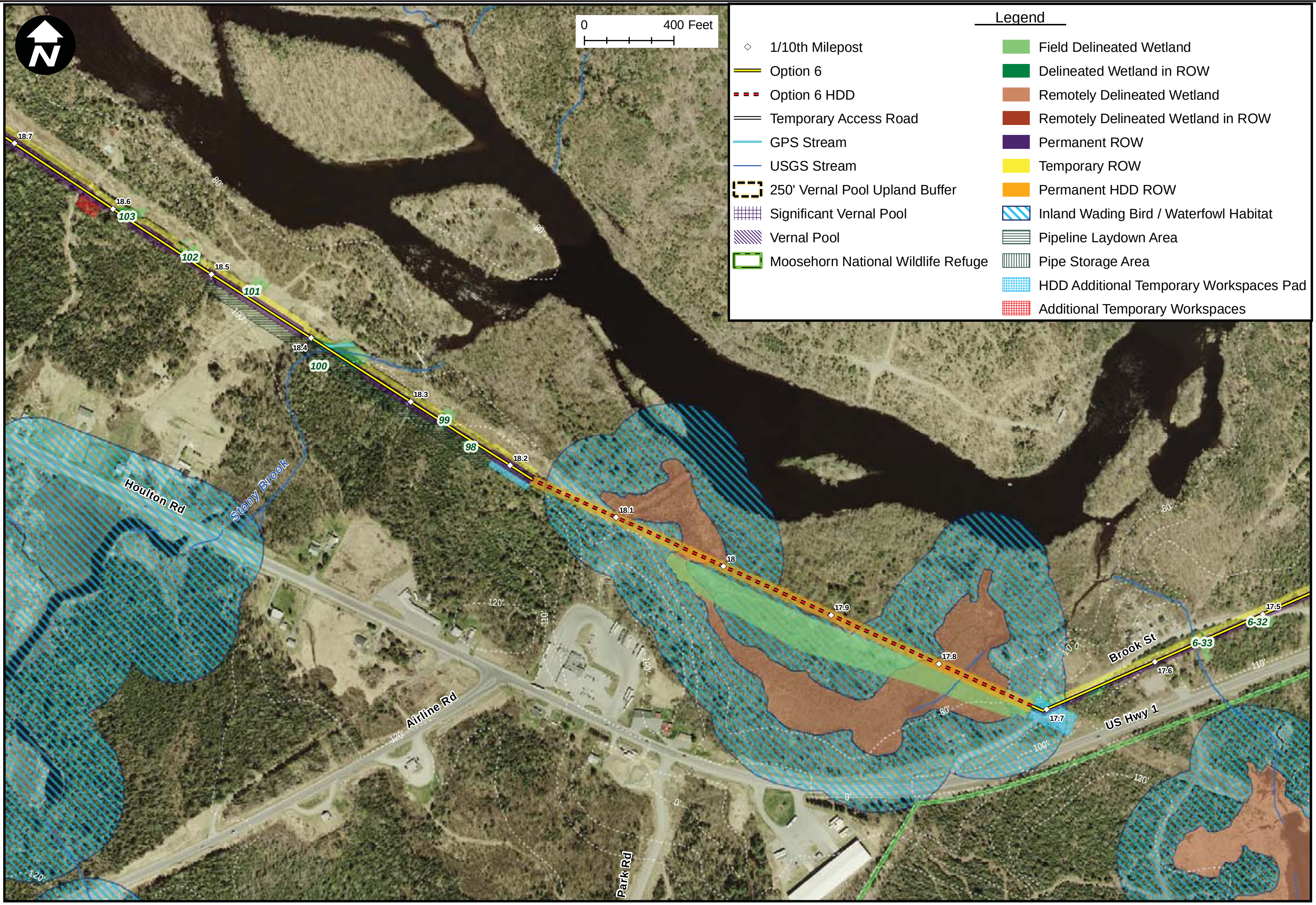

Figure M-21
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

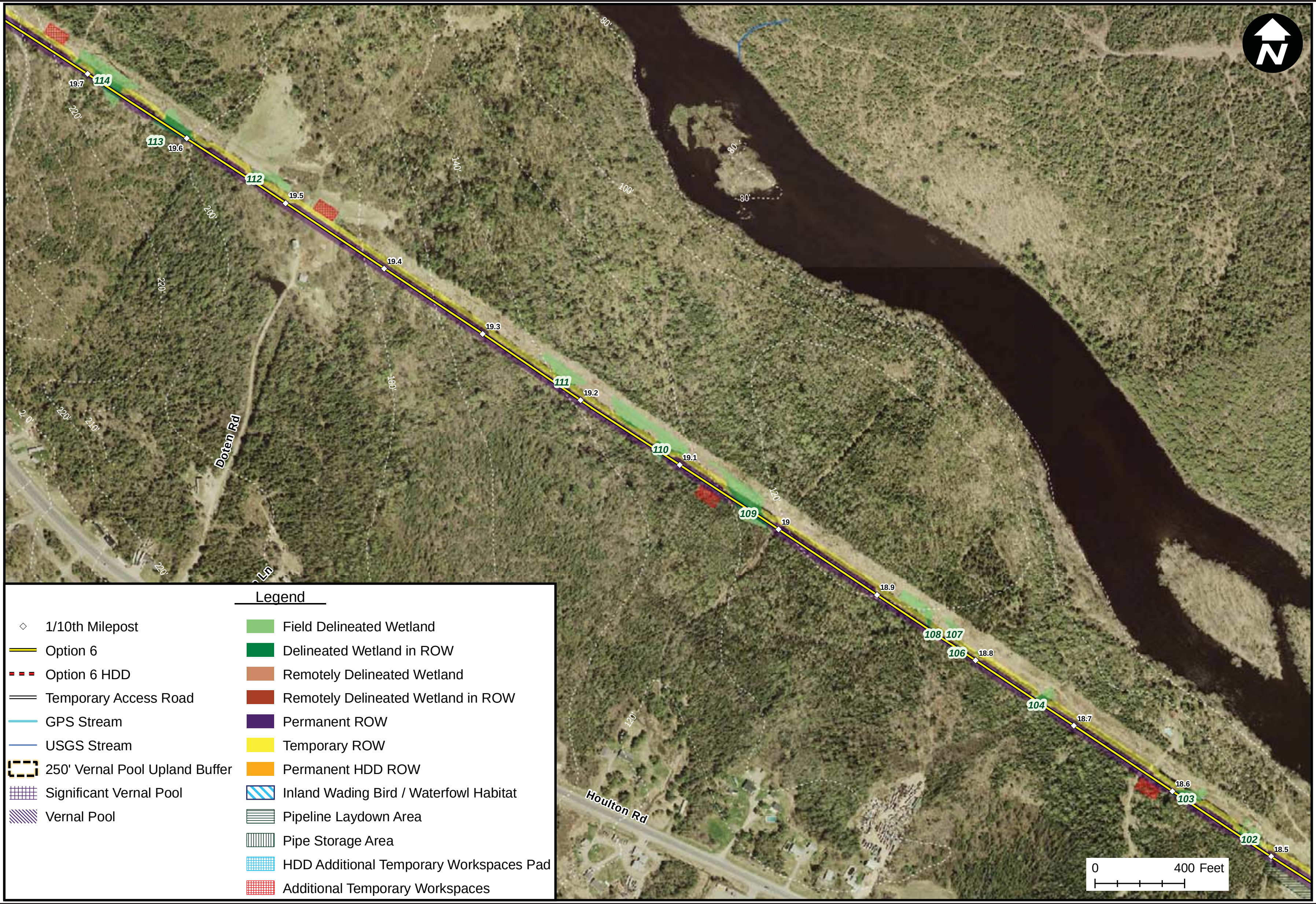

Figure M-22
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

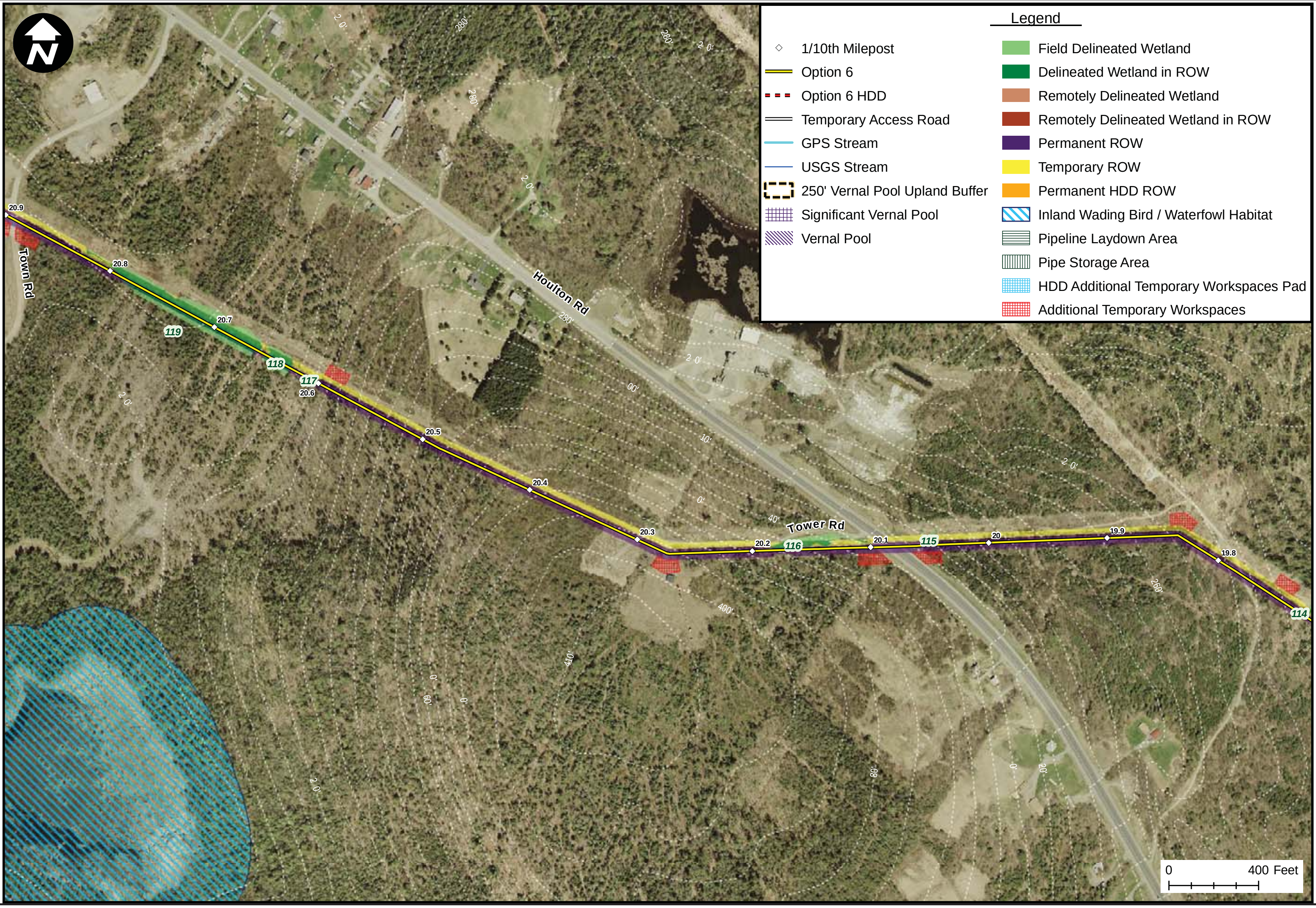

Figure M-23
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

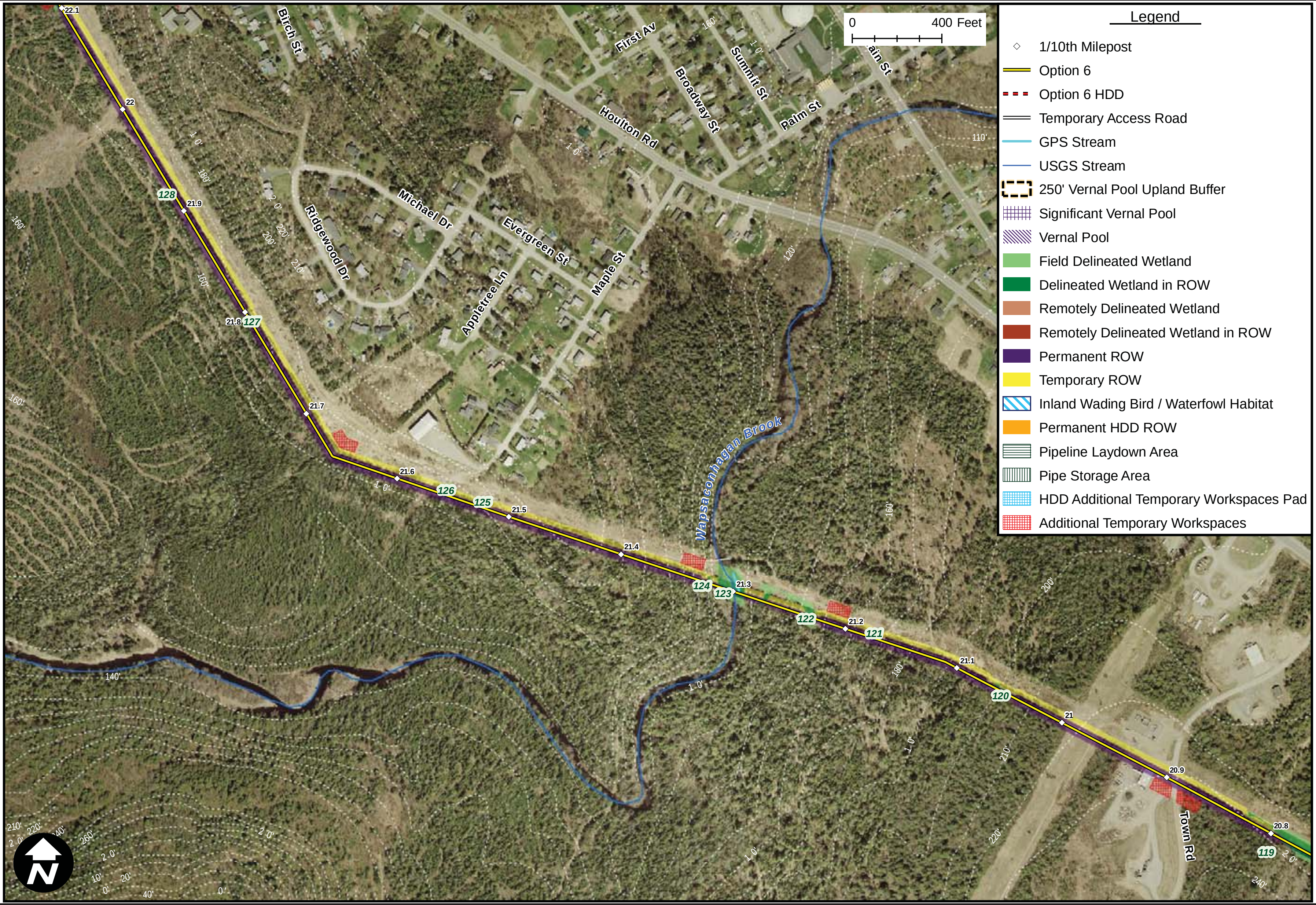

Figure M-24
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

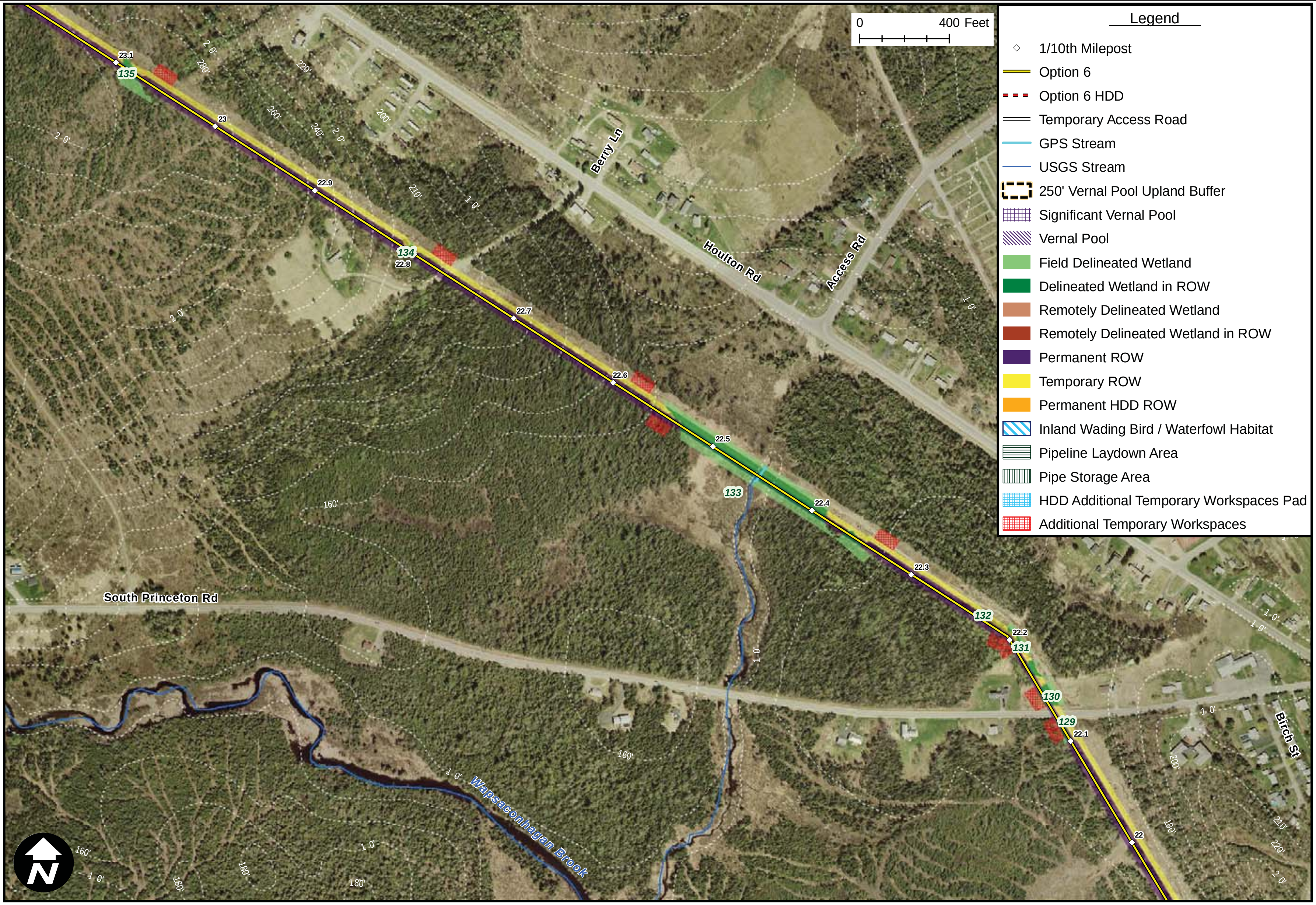

Figure M-25
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

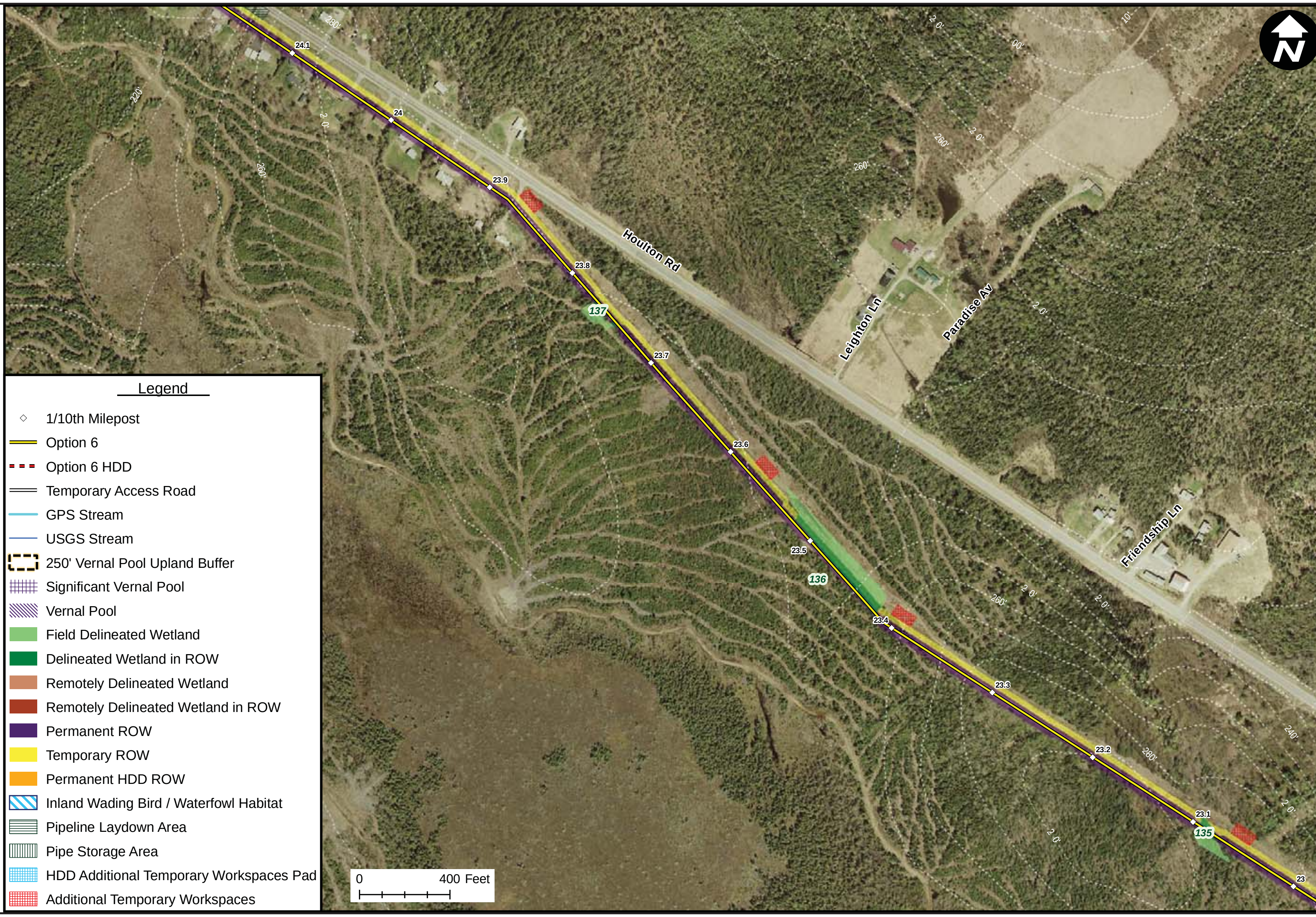

Figure M-26
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

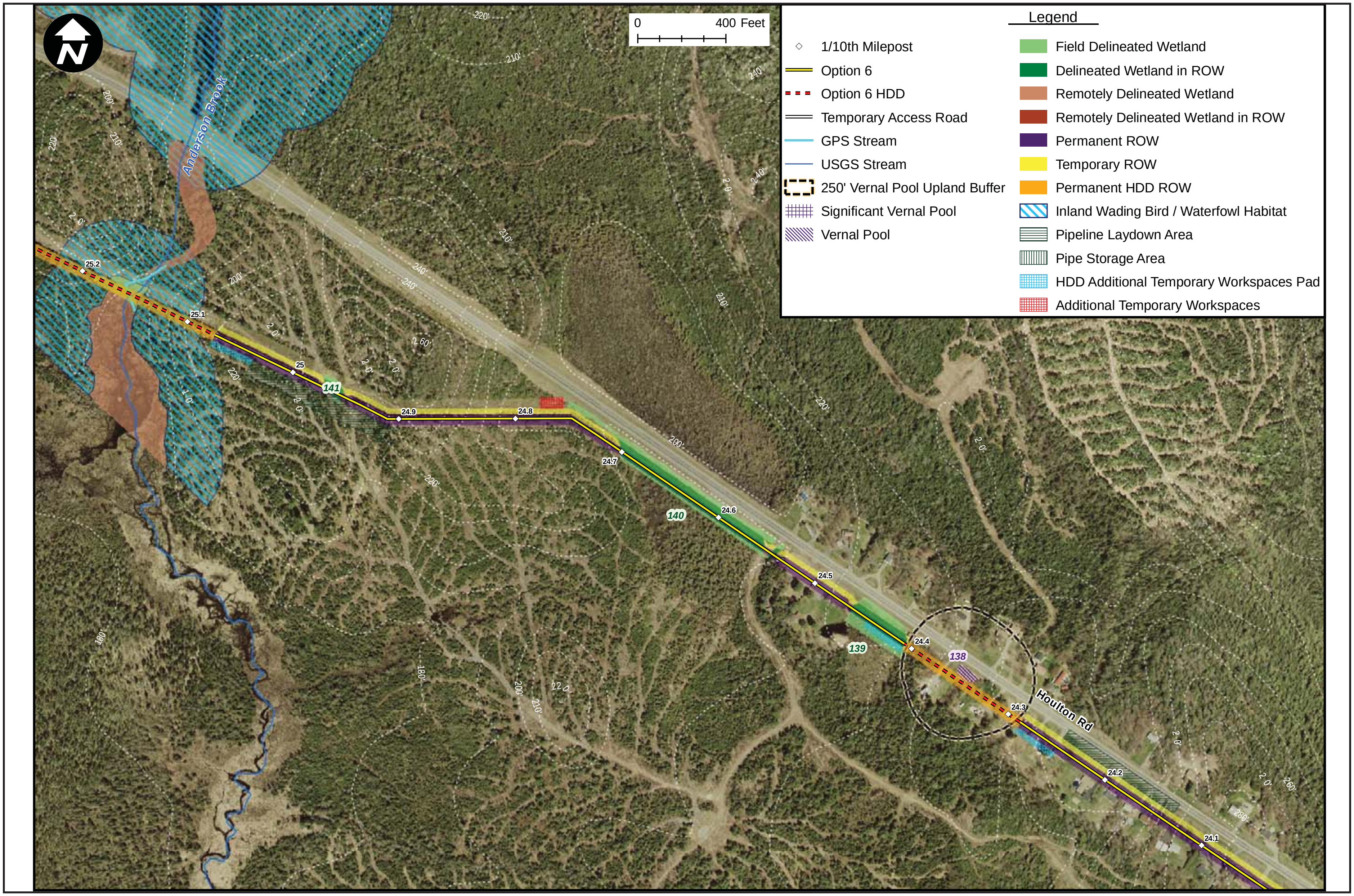

Figure M-27
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

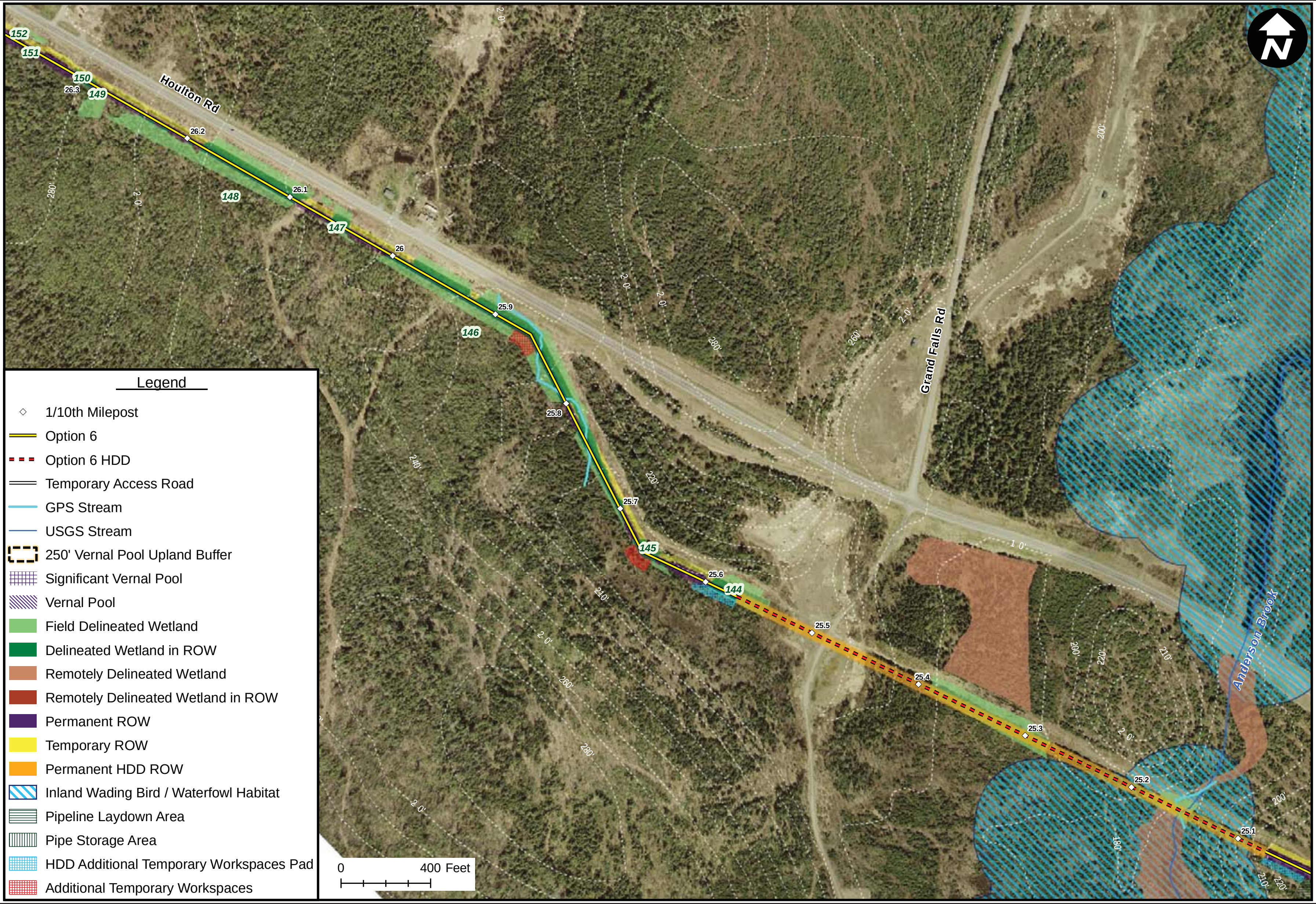

Figure M-28
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

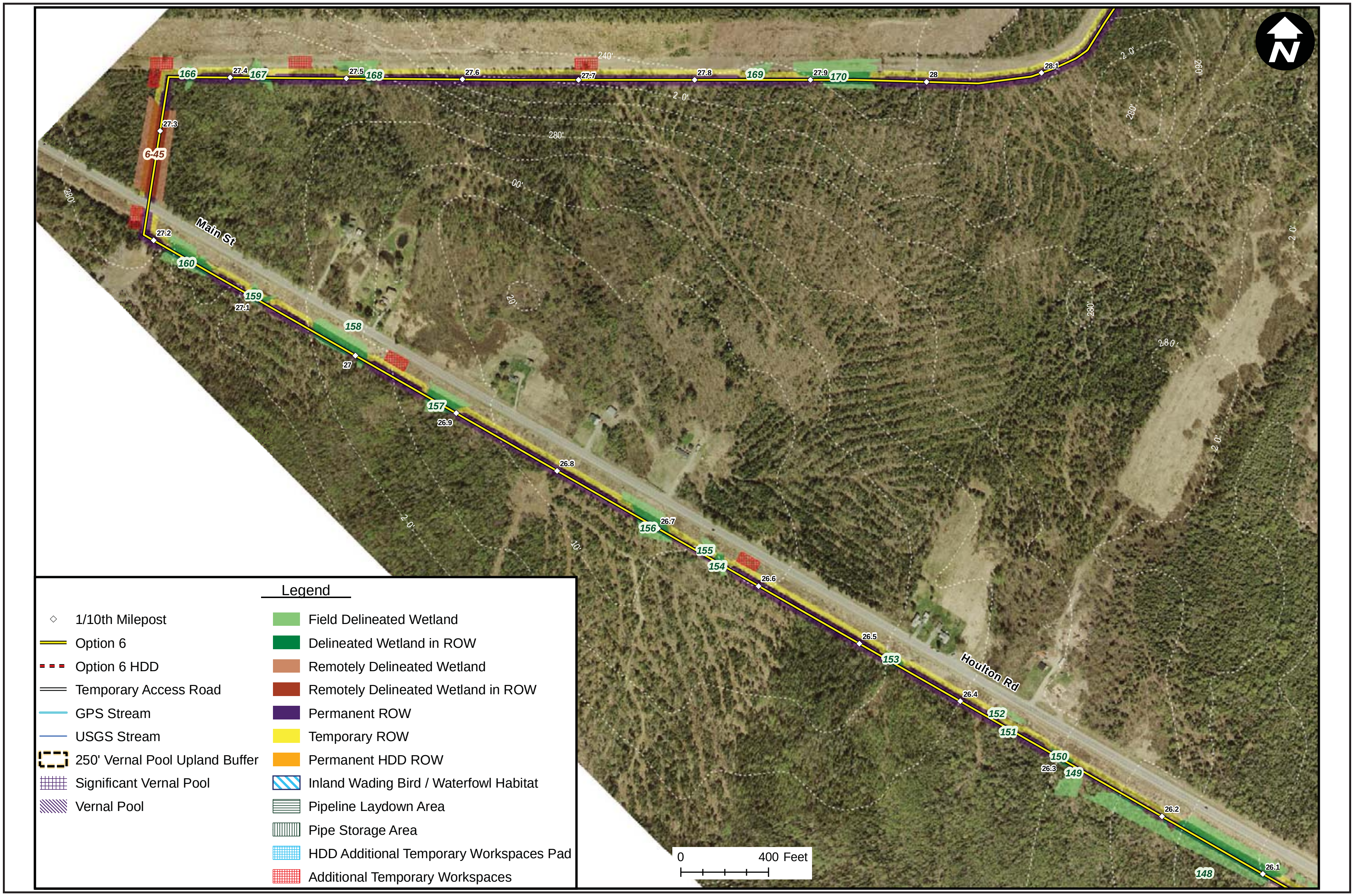

Figure M-29
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

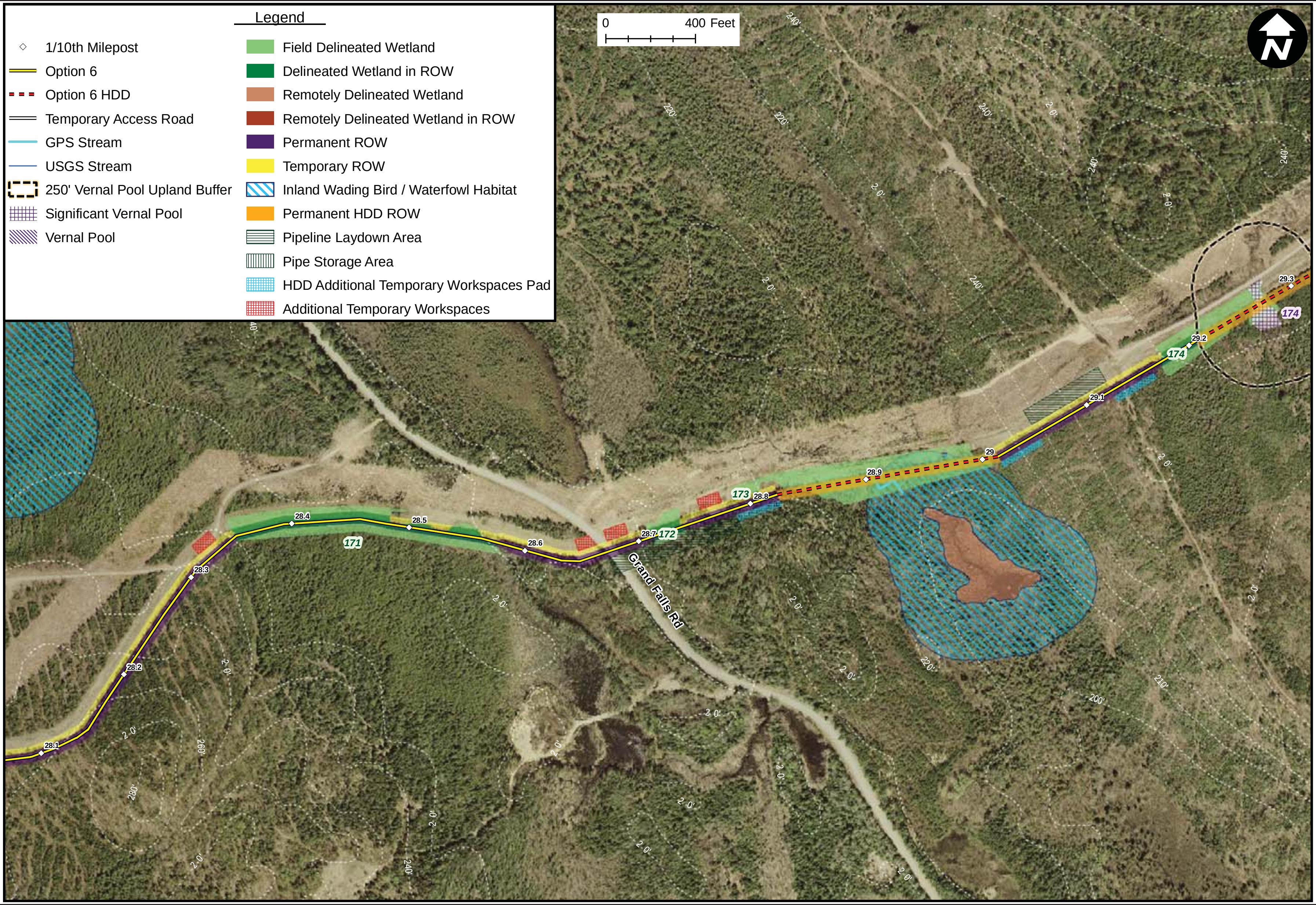

Figure M-30
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

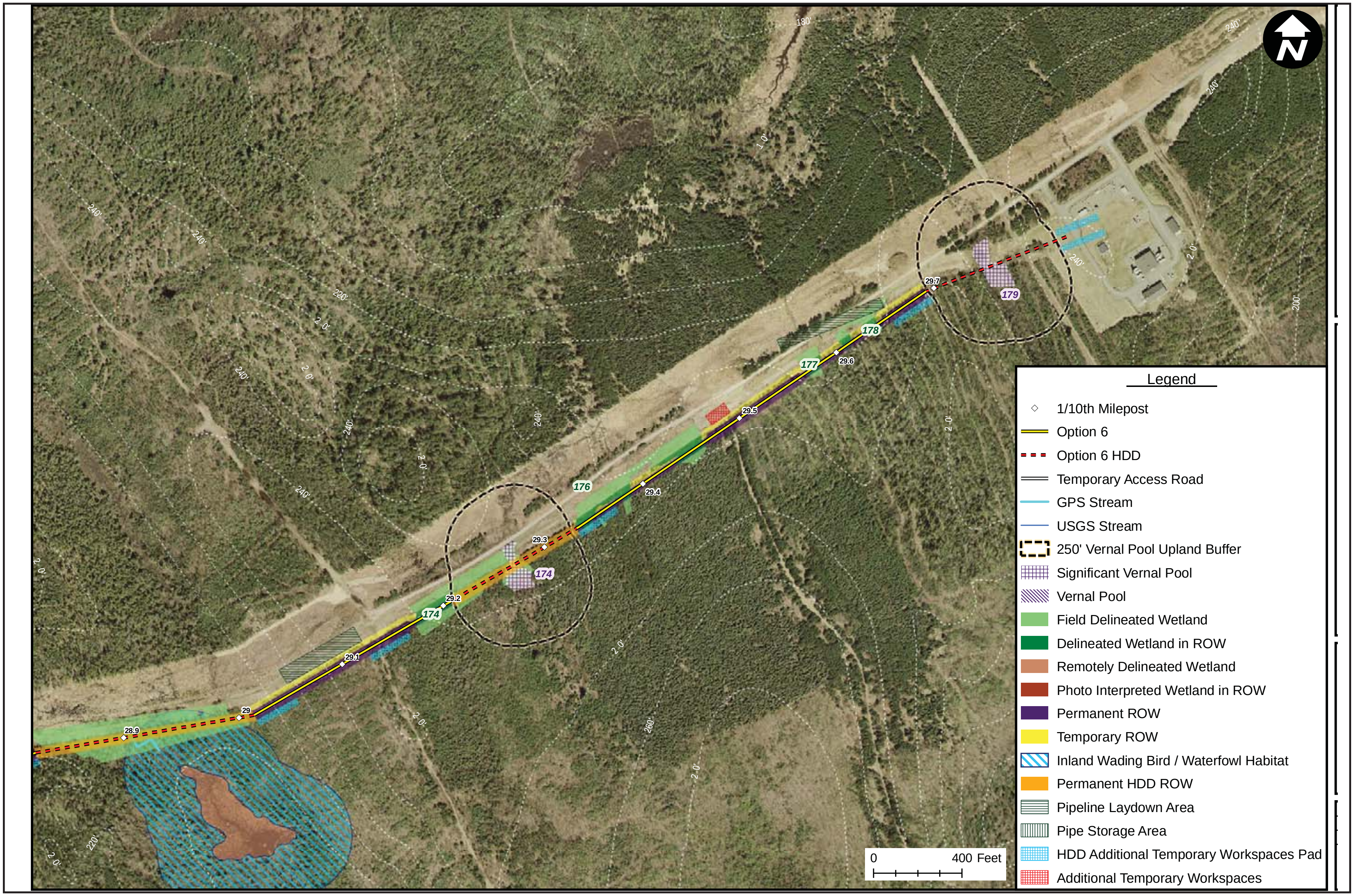

Figure M-31
Downeast LNG Project
Detailed Significant Wildlife Habitats along the Sendout Pipeline

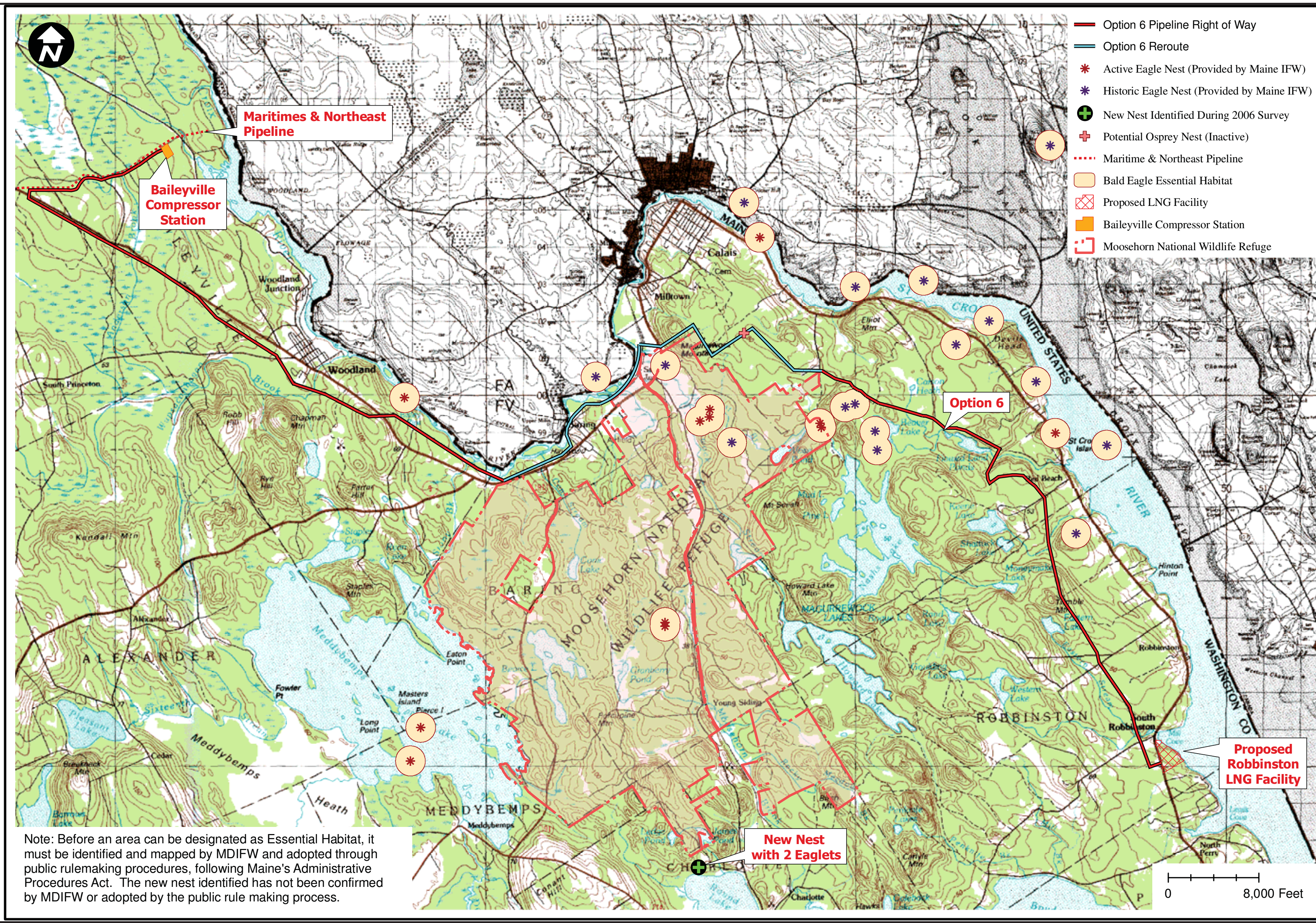

Figure M-32
Downeast LNG Project
Bald Eagle Nesting Locations

Appendix N

Shorebird Mitigation Plan

August 8, 2007

Revised Shorebird Mitigation Plan

This revised Shorebird Mitigation Plan is intended to replace the Shorebird Mitigation Plan previously submitted to the Maine Department of Environmental Protection as part of Attachment 13 to the Downeast LNG Site Location Application. The revised Shorebird Mitigation Plan was finalized during a meeting on July 27, 2007, between representatives from the Maine Department of Inland Fisheries and Wildlife (Mark Stadler and Steve Timpano) and Downeast LNG (Rob Wyatt, John Lortie and Chip Ahrens). Also present at the meeting were Jim Cassida and Jenn Cayer from DEP. The Maine Department of Inland Fisheries and Wildlife indicated its support to reopen the Board of Environmental Protection ("BEP") record to allow this revised Shorebird Mitigation Plan to be finalized and included in the BEP record.

1. Mitigation/Compensation Funds.

The Maine Department of Fisheries and Wildlife (IF&W) has proposed that provision by Downeast LNG of $3 million in property acquisition funds will offset any potential impacts to shorebird habitat from the construction and operation of the Downeast LNG terminal and facility in Robbinston, Maine. The compensation amount may be reduced through the acquisition by Downeast LNG of conservation easements or the purchase of land in Mill Cove or other locations which result in permanent protection of a 250-foot riparian buffer. Acquisitions outside of Mill Cove must be approved by IF&W prior to a reduction credit of compensation amount. The amount of the reduction will be proportionate to the linear amount of buffer that is conserved. For purposes of these calculations, IF&W proposed that one mile of shoreline buffer shall equate to a figure of $500,000 based on the base mitigation rate calculation:

> Presumed Amount of Potential Impacted Shorebird Habitat Shoreline = 0.75 miles
> Mitigation Factor to be Applied = 8:1
> Total Miles requiring Mitigation = 8 x 0.75 miles or 6 Miles total
> $500,000 per mile x 6 miles = $3.0 million

In addition to allowing reduction credits for acquisition of approved buffer by Downeast LNG, IF&W agrees that the property acquisition amount will be reduced by $500,000 through the funding of an "advancing the science" program (described below in Section 2).

The Downeast LNG mitigation/compensation funds allocated for potential shorebird habitat impacts at Mill Cove will be deposited to either a dedicated account established within IF&W exclusively to receive and hold these funds, the DEP in-lieu-fee program account, or such other account as DEP and IF&W may agree. Said funds will be used by IF&W solely for the preservation of coastal shorebird feeding or roosting areas via habitat acquisition. Acquisition will focus on the purchase of conservation easements that protect coastal shoreline habitat adjacent to shorebird feeding or roosting areas. At IF&W's discretion, these funds may be used for fee acquisition of shorebird feeding or roosting habitat.

Funding for the mitigation/compensation account by Downeast LNG shall depend upon receipt of all necessary permits, with conditions acceptable to Downeast LNG, for the proposed terminal and facility in Robbinston, as well as the proposed Pipeline. Funding of the account by Downeast LNG shall occur prior to the start of any construction. Payments may be made in accordance with a schedule to be established with IF&W provided that no construction may start prior to an agreement to the payment schedule by IF&W and approval by the BEP of the financial assurance mechanisms to make certain that Downeast LNG will be able to make all required payments on schedule.

2. Downeast LNG will provide IF&W $500,000 to establish an "advancing the science" program for shorebirds. IF&W will develop and implement science programs that further an understanding of shorebird biology and enable better management of shorebird resources. IF&W commits to spending a minimum of $250,000 on the advancing the science program but reserves the right to spend any remaining money on property acquisition for shorebird habitat protection.

3. Shorebird banding study.

Downeast LNG will conduct a shorebird banding study for five years in consultation with IF&W. The purpose of this study will be to further the understanding of shorebird biology and enable better management of shorebird resources. The program will be funded for five years and initiated within the calendar year that construction begins subject to the BEP permit. Funding for the banding study will be in an amount up to $10,000 per year. Downeast LNG will coordinate appropriate permits and scope of the study in conjunction with IF&W prior to initiation of the study. It is anticipated that the study will begin prior to construction and will continue through and after the construction period. Information on banded individuals will be collected in conjunction with pre-construction, construction, and post-construction surveys (see Section 4 below). Funds spent by Downeast LNG for the shorebird banding study will not count as a reduction credit against the mitigation/compensation funding described in paragraph 1 above.

4. Pre-construction, construction and post-construction surveys.

Downeast LNG will develop and implement surveys to document shorebird use of Mill Cove to estimate potential effects of the LNG terminal construction and operation on shorebirds. Surveys shall be designed in consultation with IF&W. An annual report of study details, results and recommendations will be prepared and distributed by Downeast LNG to IF&W and to other State and Federal natural resource agencies upon request. The annual report will also be posted on the Downeast LNG internet web page. Funds spent by Downeast LNG for the pre-construction, construction and post-construction surveys will not count as a reduction credit against the mitigation/compensation funding described in paragraph 1 above.

5. Adaptive management.

Downeast LNG will develop an adaptive management plan in consultation with IF&W for shorebirds that provides a process for identifying unreasonable adverse effects from development and operation of the LNG terminal and provides possible mitigation mechanisms. Adaptive management is intended to avoid, reduce, and minimize unreasonable adverse disturbances.

Correspondence with MDIF&W Regarding Minimization and Avoidance of Impacts to Significant Wildlife Habitats

Chip Ahrens

From: Elowe, Ken [Ken.Elowe@maine.gov]
Sent: Wednesday, August 15, 2007 12:12 PM
To: Chip Ahrens
Cc: Littell, David P
Subject: Downeast LNG

Chip,
I have reviewed the revised Shorebird Mitigation Plan proposed by Downeast LNG that you gave to me dated August 8, 2007. The revised plan accurately summarizes the discussions that we have had. If Downeast LNG were to propose to DEP this revised Shorebird Mitigation Proposal, and if the BEP were to determine that compensation for potential impacts to shorebird habitat is appropriate, then IFW will respond to DEP that Downeast has approached mitigation of shorebird issues reasonably.

Further, on the issue of vernal pools, if Downeast proposes to DEP to directional drill under the entire 250' habitat and pool, and avoid/minimize disturbance to less than 15% in the 250-500' habitat, then IFW will respond to DEP that avoidance/minimization was reasonably approached by Downeast.

Downeast has satisfactorily addressed all of the remaining open issues raised by IFW. Thank you for your response to these concerns.

Kenneth Elowe
Director, Bureau of Resource Management
Dept of Inland Fisheries & Wildlife

DOWNEAST LNG MIGRATORY SHOREBIRD ADAPTIVE MANAGEMENT PLAN

DRAFT PROVIDED TO MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE AUGUST 2007

1.0 INTRODUCTION

Downeast LNG has developed an Adaptive Management Plan designed to reduce or eliminate impacts to migrating shorebirds during the construction and operation phases of the Downeast LNG facility. The plan has identified potential sources of shorebird impacts, and proposes appropriate adaptive management solutions to reduce or eliminate potential negative impacts. Negative impacts to feeding shorebirds will be assessed statistically and behaviorally by conducting a predevelopment shorebird population study of existing conditions designed to document the number of shorebirds by species and their distribution within Mill Cove, which can be subsequently compared to shorebird numbers and distribution documented during the construction and operation phases of the project. Downeast LNG will also track shorebird usage of the salt marsh west of the Route 1 culvert entering into Mill Cove. If statistically significant changes in shorebird numbers or shorebird distribution within Mill Cove occur, appropriate adaptive management options described in the plan will be immediately implemented. This statistically sound evaluation protocol provides an objective method for evaluating shorebird impacts, thus eliminating subjectivity and false conclusions.

Downeast LNG has already initiated adaptive management strategies for shorebirds prior to the drafting of this plan. This includes original siting of the pier to the outer part of the cove area and more recent modifications of the pier and lighting in a way that will not allow light to spill from the deck of the pier. In addition, Downeast LNG has investigated other LNG pier operations and determined that the use of combustion engine motor vehicles on the pier during normal operations can be precluded. Electric battery powered vehicles (such as golf carts or equivalent) will be used instead (as is done at the EcoElectrica Pier of 1,782 feet), which will be much quieter and will be governed to ensure speed limits under 10 miles per hour (also an operational condition at EcoElectrica).

2.0 ASSESSMENT METHODS

To assess if there are significant changes in shorebird numbers, shorebird species, or shorebird distribution in Mill Cove and the salt marsh west of the Route 1 culvert during the construction and operation phases, Downeast LNG is conducting a time-activity study in Mill Cove to quantify the numbers and distribution of shorebirds in Mill Cove throughout the tidal cycle under existing conditions. These data, combined with the 2006 shorebird survey results, will serve as baseline data to compare to similar surveys to be conducted during construction and the first three years of operation.

The "Shorebird Survey and Impact Assessment Protocol for Mill Cove" to be used as the shorebird impact assessment method is described on the next page.

2.1 Potential Sources of Shorebird Disturbance

Disturbance to feeding shorebirds from Downeast LNG site activity or other non-project related activities may include:

- Physical presence of Downeast LNG employees and/or company visitors (or the presence of people regardless of project activities),
- Physical disturbance and noise from vehicles and boats (project and non-project related),
- Changes to feeding substrates caused by siltation and nutrient enrichment, and

- Harassment by pets (non-project).

Two levels of shorebird impacts may occur: 1) avoidance, under-utilization, or complete abandonment of specific sections of the intertidal zone compared to pre-development shorebird use patterns, or 2) a reduction in total numbers of shorebirds, including complete abandonment, in Mill Cove.

2.2 Shorebird Survey and Impact Assessment Protocol for Mill Cove

Woodlot Alternatives has initiated a weekly shorebird survey in Mill Cove, beginning 25 July 2007. Woodlot will conduct weekly counts through the last week of September. If shorebirds are present in late September, the survey will continue into mid-October. This program will continue through the first year of Terminal operation.

- Survey Frequency: A minimum of 10 surveys by the end of September.
- Survey Dates: The exact date of each survey will be determined by the tide and appropriate weather.

The survey protocol is designed to answer four questions:

1) What shorebird species and how many of each feed in Mill Cove?
2) Where do shorebirds go when they arrive to feed?
3) Where do shorebirds move and feed as the tide recedes?
4) Do shorebirds roost along any part of Mill Cove?

The objective of this protocol is to follow every bird or flock through an entire descending tide. Two biologists will plot each individual or flock on reference maps and track their movements using this spot mapping technique.

To better determine where shorebirds are feeding at Mill Cove, the cove has been divided into 5 units. These units have been established considering the following criteria:

1) Each unit has a fairly distinctive micro-habitat feature.
2) The frontage of each of the three units along the shoreline is reasonably similar.
3) Each unit is clearly definable to facilitate accurate mapping of bird distribution.

Each survey will be initiated shortly after high tide when the cove is full of water. Each survey will track shorebirds for every 30 minute period, and will track bird arrivals and movements until low tide. There will be two observers placed in separate areas of Mill Cove to provide complete coverage. The observer in the south side of the cove will check the pier area for both roosting and feeding shorebirds and will scan the two small coves to the south of Mill Cove for feeding shorebirds. Observers will be in communication using radios to track shorebird movements.

Because the area of each unit differs, shorebird densities will be calculated as birds/unit area in the final report.

This protocol should provide detailed information regarding shorebird micro-habitat use in relation to the height of the tide.

2.3 Determination of Impacts

Assessment of under-utilization and abandonment of feeding habitats will be based on the pre-development shorebird habitat use patterns determined through the pre-construction time-activity study of fall migrating shorebirds. Disturbance to feeding shorebirds typically occurs at distances considerably less than 200 feet, but remediation or adaptive management actions will occur throughout the affected area plus another 100 feet beyond the maximum documented disturbance distance from a putative source.

Downeast LNG will not mitigate for disturbance impacts not associated with Terminal operations, including but not limited to, beach combers, hikers, recreational boaters; pets; recreational and commercial fin fisherman; clam, periwinkle, and marine worm harvesters; lobster and crab fisherman; scallop, mussel, sea cucumber, and urchin draggers; and automobiles along U.S. Route 1.

3.0 SOURCES OF DISTURBANCE AND ADAPTIVE MANAGEMENT ACTIONS

3.1 Vehicle and Pedestrian Disturbance on the Pier

During normal operations, including when a carrier is unloading, no combustion engine motor vehicles will normally be allowed on the pier. Motor vehicles will be limited to times when equipment parts of larger size are moved to the end of the berth for other types of occasional pier maintenance or when a greater work scope is required that an electric motor vehicle could not perform (e.g., snowplowing). No regular maintenance activities will be scheduled during periods in which shorebirds are feeding in the area. During all other times, electric vehicles will normally be used on the pier, which will eliminate noise from vehicles on the pier. Electric vehicle traffic to the end of the pier is expected to average six round trips per 24 hour period (3 shift changes and three miscellaneous trips) except when a LNG carrier is present, which are expected to average up to once every 5 to 7 days during the fall shorebird migration. Regular pedestrian traffic on the pier is not expected. Traffic speed on the one-lane pier will be 10 mph or less. Because the pier is raised between 11 and 12 feet above the high tide level over inundated intertidal feeding substrates, most vehicles are expected to be out of the direct line of sight of feeding shorebirds near the pier.

Adaptive Management Actions: If a statistically significant reduction in shorebird use occurs within 300 feet of either side of the pier, visual barriers will be placed along the first 300 feet of the pier, which includes 247 feet located over intertidal flats. These barriers will consist of a four-foot wall or visual barrier in this area to reduce any traffic related noise attenuation or light spilling over the deck of the pier.

3.2 Disturbance from the Unloading Facility

Similar to potential disturbances by LNG carriers, sound levels will not exceed Maine Department of Environmental Protection (MDEP) permit standards. The unloading facility is located more than 1,200 feet from the nearest area that shorebirds feed.

Adaptive Management Actions: If the unloading facility is identified as a source of shorebird disturbance, the location of the disturbance agent will be identified and remediation actions will follow. Sound sources will not be allowed to exceed permit standards. Further, sound attenuation may be effected by a combination of actions, including equipment replacement or modification, constructing sound barriers around the sound source, changing the time of disturbance-producing activities to the time interval between rising half tide and falling half tide, or lining the side of the pier facing the intertidal flats with sound absorbing material.

3.3 Shading of Intertidal Flats and Presence of a Pier

IF&W is concerned that the pier's presence, including shading of intertidal flats, may render that area under the pier and 300 feet on either side unusable by feeding shorebirds.

The impacts of pier avoidance by feeding shorebirds will be evaluated by comparing baseline predevelopment shorebird feeding patterns along 300 feet on either side of the proposed pier footprint to shorebird feeding patterns in the same area during construction and post-construction. As described previously, predevelopment or baseline shorebird numbers and shorebird use patterns will be determined using a time-activity study designed to document the number of shorebirds present on the flats and where they are feeding throughout the tidal cycle. In the event there is a significant change in shorebird use patterns in the shade under the pier or next to the pier, adaptive management actions will be considered.

Adaptive Management Actions: Downeast LNG will ensure that the outset of pier construction at the shoreline area will not be initiated or conducted during the high use period of significant shorebird activity in the same area (as determined by baseline conditions). For example, if the shorebirds of interest are found to be using the area immediately near where the pier will abut the shoreline as it enters the landside facility, construction of this project component will not be initiated during the time that such activity would be anticipated (e.g., July 21 thru August 21).

No other adaptive management protocol, with the exception of a Shorebird Conservation and Mitigation Plan, has been identified at this time to address the assumed absence of shorebird use of shaded habitat under to the pier (plus habitat 300 feet on either side of the pier). As a replacement for additional adaptive management actions, the Shorebird Conservation and Mitigation Plan (submitted to IF&W under separate cover for review) includes contribution to a habitat protection fund, funding of ‘advancing the science’ studies, a shorebird banding program, and shorebird habitat use studies prior to, during, and after construction.

3.4 Disturbance from Dogs

Pets, in particular unrestricted dogs, can severely impact feeding shorebirds. Both employees and visitors will not be allowed to have pets, for any purpose or period of time, at the Downeast LNG Terminal.

Adaptive Management Actions: Downeast LNG will prohibit employee or visitor owned pets from the LNG storage facility pier, unloading facility, and intertidal flats to prevent harassment of shorebirds. If dogs are observed causing disturbance to shorebirds in Mill Cove, regardless of the source, Downeast LNG will work with IF&W to post signage near the MDOT turnouts to help educate visitors about the potential impact from dogs in shorebird areas.

Appendix O

Ichthyoplankton and Zooplankton Sampling Results and CORMIX Modeling Report

Interim Report

Ichthyoplankton and zooplankton sampling results
Downeast LNG
Mill Cove, Robbinston, Maine

Prepared for

Downeast LNG
PO Box 147
Robbinston, ME 04671

207- 454-3925

by

MER Assessment Corporation
14 Industrial Parkway
Brunswick, Maine 04011
207-798-7935 (V)
207-729-4706 (F)
207-751-3696 (C)

1 May 2008

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Introduction

Downeast LNG is conducting ichthyoplankton and zooplankton sampling in Mill Cove, Robbinston, Maine to develop site-specific data to be used in refining estimates on potential impacts resulting from seawater usage related to vessel cooling, vessel ballasting, and fire suppression system testing.

A preliminary ichthyoplankton-only sampling effort was carried out on October 25, 2006 using a single 75 cm circular frame with a 363µm mesh net towed by an 18-foot boat (see Figure 1). A YSI 6600 profiler sonde was used to monitor depth of the net on a real-time basis and an Onset Computer Corporation HOBO® water level logger (Model No.U20-001-02) attached directly to the net bridle was used to record actual net depth. Vessel location, direction, and speed were monitored using a Garmin 182 Chartplotter. A General Oceanics flowmeter (GO Model No. 2030) affixed to the approximate center of the net frame was used to calculate volume of water sampled and distance traveled based on actual flow through the net.

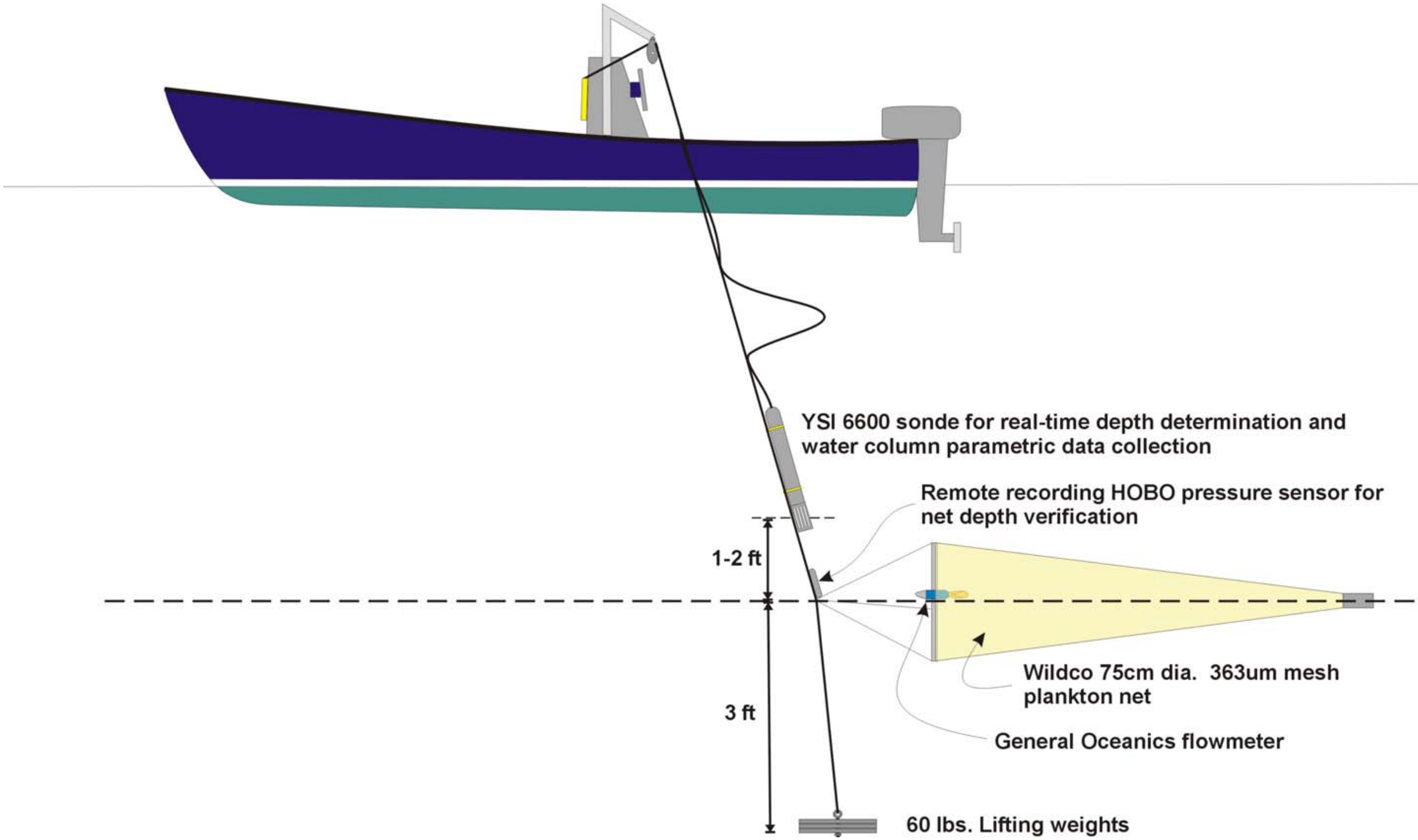
Fifteen minute tows were made at a target depth of 30-35 ft. (≈33 ft. mean) and as a composite of three five-minute tows at each of three depths: 2 meters above the sea floor, target depth (30-35 ft.), and 1 meter below the sea surface at three times over the course of the day and night. One target depth and one composite depth sampling was conducted during daylight hours between one hour before and after the morning low tide, another during daylight hours between one hour before and after the afternoon high tide, and once at night between one hour before and after low tide. Tows were made within the immediate vicinity of the proposed vessel docking area. Tow speed was maintained between 1 and 2 knots and tow direction was oblique to the current direction at the time of sampling. Samples were delivered to Dr. Lou Van Guelpen at the Atlantic Reference Collection (ARC), St. Andrews, New Brunswick, Canada for analysis. Data collected during the initial October 2006 sampling tows and the results of the sample analyses are included here as Figure 5 and 6 and Tables 1 and 2.

Following discussions with NOAA Fisheries a sampling protocol was developed which is included here beginning on Page 3. This protocol calls for inclusion of zooplankton sampling, thus the use of a Bongo net assembly, the weight of which requires use of a larger vessel as shown in Figures 2-4.

The first round of sampling conducted under the NOAA Fisheries requested and approved protocol was done on February 27, 2007, a second on May 28, 2007, a third on August 16, 2007, the fourth on September 15, 2007, fifth on October 25, 2007, and the most recent on February 19, 2008. Ichthyoplankton samples were processed by Dr. Lou Van Guelpen of ARC. Zooplankton samples were processed to Dr. Ray Gerber, Brunswick, Maine. Data collected during the February, May, August, September, October, and February sampling tows and the results of the ichthyoplankton and zooplankton sample analyses are included here as Figure 7-18 and Tables 3-21.

Estimation of potential Equivalent Adult Fish Loss (EqAF) shown in Tables 2, 4, 7, 10, 13, 16, and 20 assume a "worst-case" seawater volume usage of 211,421m^3 for engine cooling and ballasting per visit and approximately 45.5 visits per winter and 22.8 during the summer. EqAF losses are shown using three possible survival ratios: 1:100,000, 1:10,000, 1:1,000. Summaries of fish egg, fish larvae and zooplankton based on sampling date results are shown in Table 22. Individual species losses due to ship cooling in winter and summer are shown in Tables 23 and 24, respectively. Individual species losses resulting from fire suppression equipment testing in winter and summer are shown in Tables 25 and 26, respectively. Overall worst-case and seasonal fish egg, fish larvae, and zooplankton losses from ship cooling and fire suppression equipment testing are shown in Tables 27-32.

Figure 1. Arrangement for ichthyoplankton net deployment October 25, 2006



Ichthyoplankton and zooplankton sampling protocol

12/5/2006

Revised 01/12/2007

Pre-sampling equipment calibration

General Oceanics flowmeter

The General Oceanics flowmeters (GO Model No. 2030) to be used to calculate volume of water sampled and distance traveled will be calibrated prior to use in the field. Calibration will be done under still water conditions, such as a swimming pool, by attaching the flowmeters at the approximate center of a weighted ring with no net attached, recording the flowmeters counter starting readings, towing the vertically aligned ring through the water over a known distance, and finally recording the ending counter readings. Distance traveled is calculated using the equation

$$D = (C \times R) / 999{,}999$$

where D is the distance traveled in meters,
C is the difference between ending and starting readings, or "counts" on the flowmeter counter, and
R is the flowmeter standard speed rotor constant equal to 26,873

The resulting calculated distance will be compared to the actual measured distance traveled and, if necessary, a correction coefficient will be developed for each flowmeter.

YSI 6600 sonde

The YSI 6600 sonde is returned to the factory annually for maintenance and manufacturer's calibration. Additionally, the YSI 6600 sonde undergoes a benchtop calibration prior to each use. Benchtop calibration includes accuracy check of the temperature probe by comparison to an NIST Standards traceable thermometer at ±0.1ºC, both immersed in the same solution; salinity probe calibration using a 50,000 microsiemens/cm [3.30% (33.0 ppt/psu) potassium chloride] YSI conductivity calibration standard (YSI 3169); dissolved oxygen sensor using the YSI calibration chamber at 100% humidity and comparing resulting mg/l and % saturation values to calculated values for same temperature and barometric pressure; and two-point pH probe calibration at pH of 7.00 and 10.00 using YSI standard buffer calibration solutions, YSI 3822 and YSI 3823, respectively. A post-sampling calibration check is performed as soon after sampling as possible to confirm calibration held throughout the sampling period. Depth calibration is performed in the field by holding the YSI 6600 sonde such that the depth probe is just above the sea surface and setting depth at 0.0 meters.

Onset Computer Corporation HOBO® water level logger

The Onset Computer Corporation HOBO® water level logger is calibrated by immersing the recording logger in water of a known (measured) depth, *e.g.* 1 foot (0.3 meters), for approximately one minute and recording the time of calibration. At time of readout the calibration period readings are compared to the known (measured) depth and any necessary adjustments/corrections made to the sampling period readings. A second HOBO® water level logger is allowed to record onboard the vessel during sampling to allow correction for any changes in barometric pressure.

Ichthyoplankton and zooplankton sample collection

Ichthyoplankton and zooplankton sampling tows will be conducted using a 0.61 meter diameter bongo frame equipped with dual 333µm mesh 1:5 diameter to length ratio nets (General Oceanics BN61-0333F), each equipped with a 1-liter polyethylene cod end collection jar. The bongo net assembly will be deployed using either nylon or similar line or steel cable. A General Oceanics flowmeter will be suspended near the center of each net ring to allow calculation of volume of water sampled by each net.

An YSI 6600 sonde will be attached approximately 0.4 to 0.6 meter above the bongo net frame and will be used to collect water quality information and provide real-time net depth to the vessel operator via a YSI 650 MSD handheld display; vessel speed and length of the tow line will be adjusted to maintain proper sampling depth. An Onset Computer Corporation HOBO® water level logger (Model No.U20-001-02) will be attached to the tow line or directly to the bongo net frame to remotely record net depth throughout the towing period and will serve as verification of sampling depth (refer to Figure 1).

Fifteen minute tows will be made at a target depth of 30-35 ft. (≈33 ft. mean) and as a composite of three five-minute tows at each of three depths: 2 meters above the sea floor, target depth (30-35 ft.), and 1 meter below the sea surface. One target depth and one composite depth sampling will be conducted during daylight hours between one hour before and after low tide, during daylight hours between one hour before and after high tide, and at night between one hour before and after either high or low tide. Tows will be made within the immediate vicinity of the proposed vessel docking area. Tow speed will be maintained between 1 and 2 knots and tow direction will be oblique to the current direction at the time of sampling. Tow course and speed will be maintained using a Garmin 182 chartplotter or similar GPS unit.

Ichthyoplankton and zooplankton samples will be placed in Nalgene containers bearing pre-labeled internal and external sample identification labels immediately after collection and preserved in 5% buffered Formalin. Organisms can be relaxed in an isotonic magnesium chloride (MgCl) solution prior to fixing, if requested by the analyzing laboratory. Ichthyoplankton samples will be delivered to the Atlantic Reference Collection (ARC) laboratory, St. Andrews, New Brunswick for analysis; a zooplankton analysis laboratory has not yet been identified.

Sampling schedule

The ichthyoplankton and zooplankton sample collection procedure described above will be carried out once in each of winter, spring, summer, and fall of 2007. For this purpose, winter will include the months of December, January, and February; spring will include the months of March, April, and May; summer will include the months of June, July, and August; and fall will include the months of September, October, and November.

Results reporting

Results will be reported in tabulated and/or graphic formats. Examples of graphic results presentation formats of the YSI 6600 and HOBO water level logger data from previous sampling are shown in Figures 2 and 3. Sample collection data concerning times, depth, flowmeter counter readings, calculated volumes sampled, etc. will be summarized in tabular form as shown in the example in Table 1. Sample analysis results will be similarly tabulated as shown in Table 2.

Note:

Volume traveling through the ring, or **sample volume**, is calculated by the equation

$$V = \frac{3.14 \times (N_{dia})^2}{4} \times D$$

where V is volume in m^3,
N_{dia} is the diameter of the ring (mouth of net) and
D is distance traveled in meters (calculation shown under Pre-sampling equipment calibration)

Speed of travel through the water is calculated by the equation

$$S = (D \times 100) / T$$

where S is speed in cm/sec,
D is distance traveled in meters, and
T is time in seconds
Division of S by 52cm/sec yields speed in knots.

Figure 2. Arrangement for ichthyoplankton and zooplankton net deployment February 27, 2007 through February 19, 2008

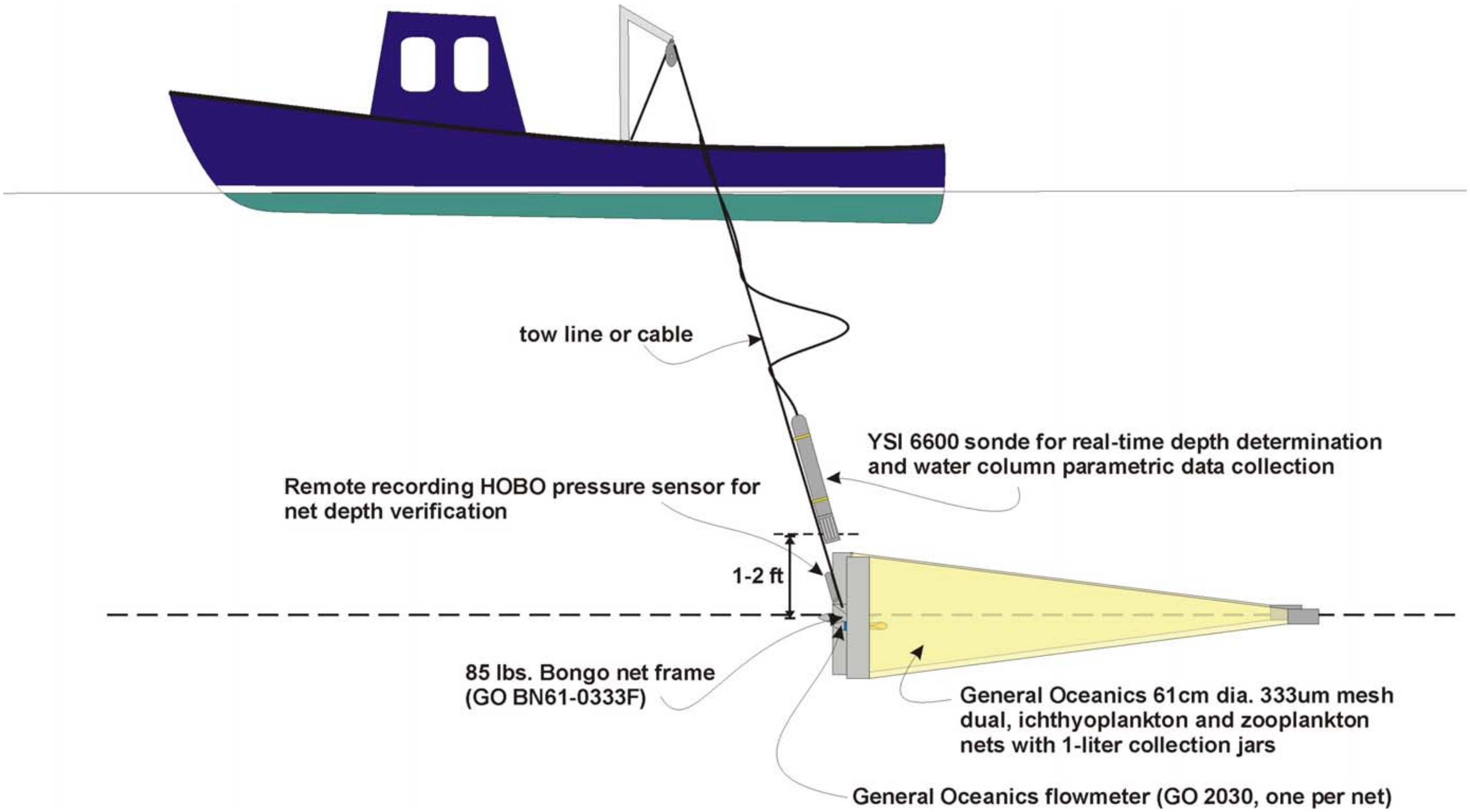


Figure 3. Arrangement bongo net assembly ready for deployment (frame view)

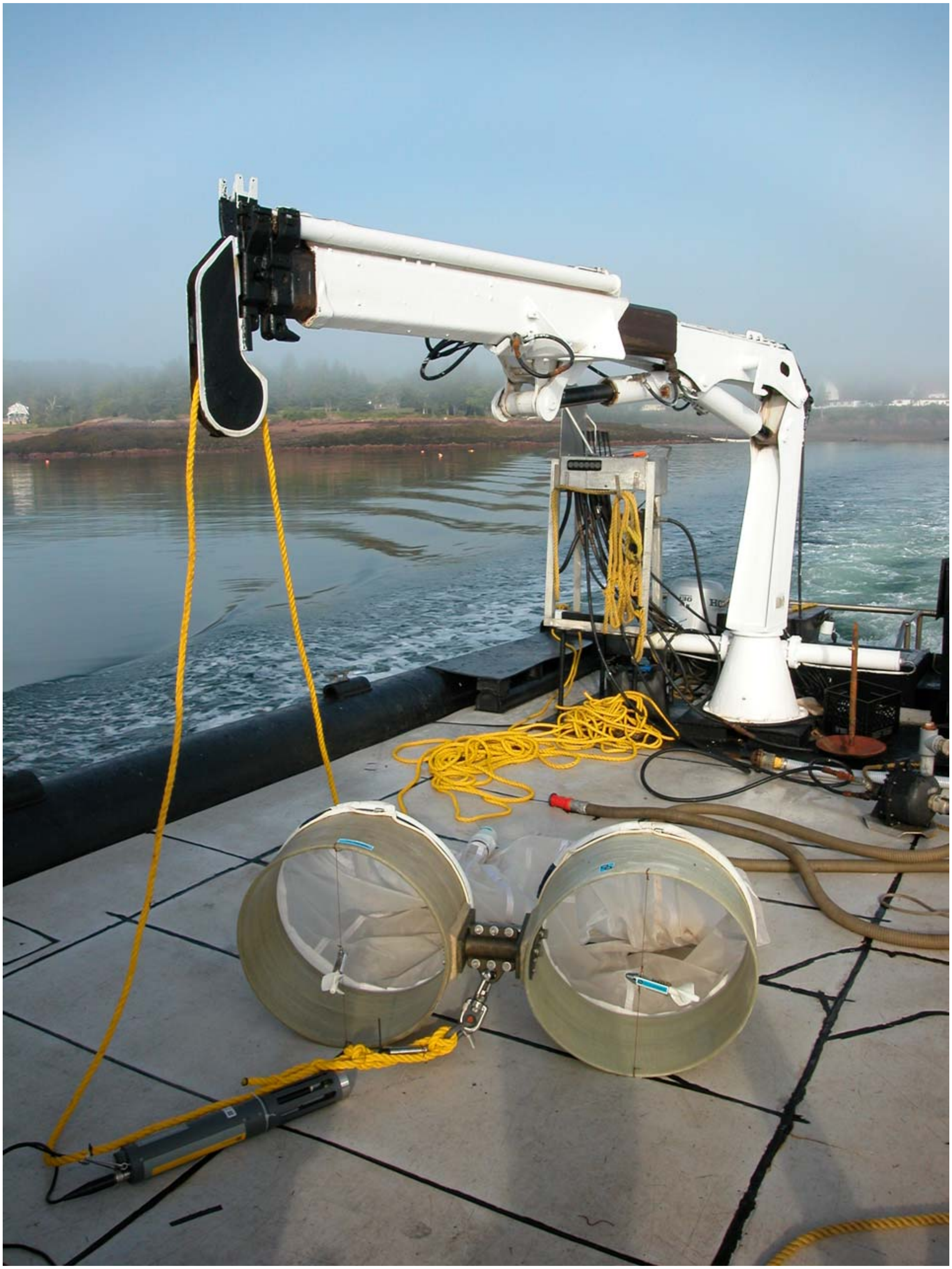
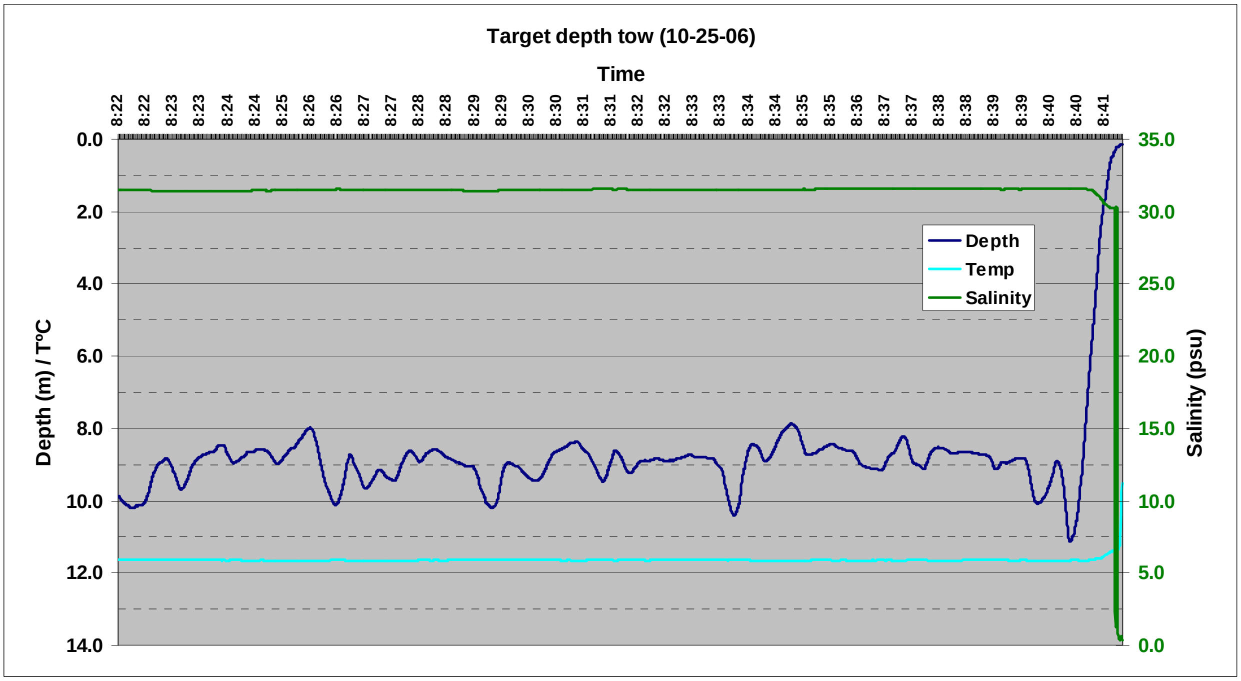


Figure 4. Arrangement bongo net assembly ready for deployment (net view)

Results

Figure 5. YSI 6600 output from the AM Low water October 25, 2006 sampling



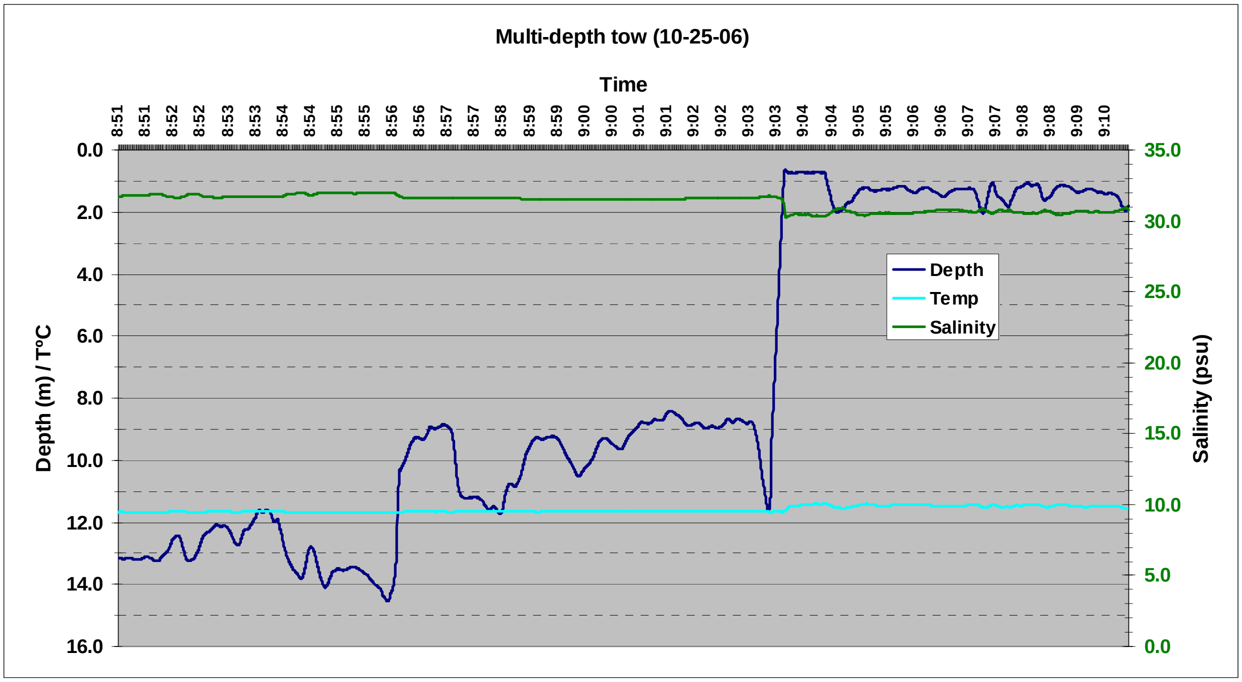
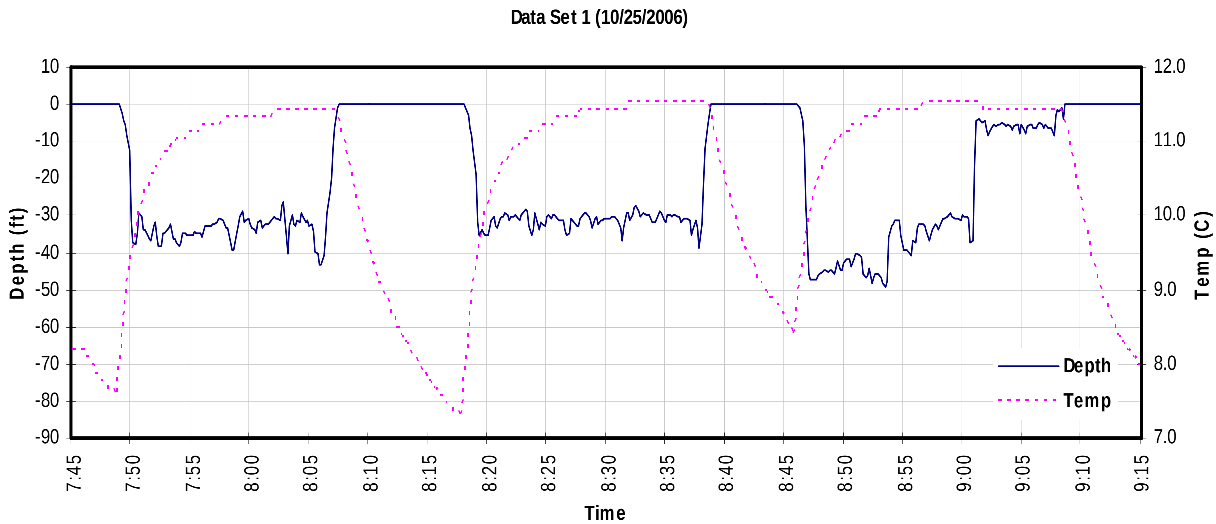
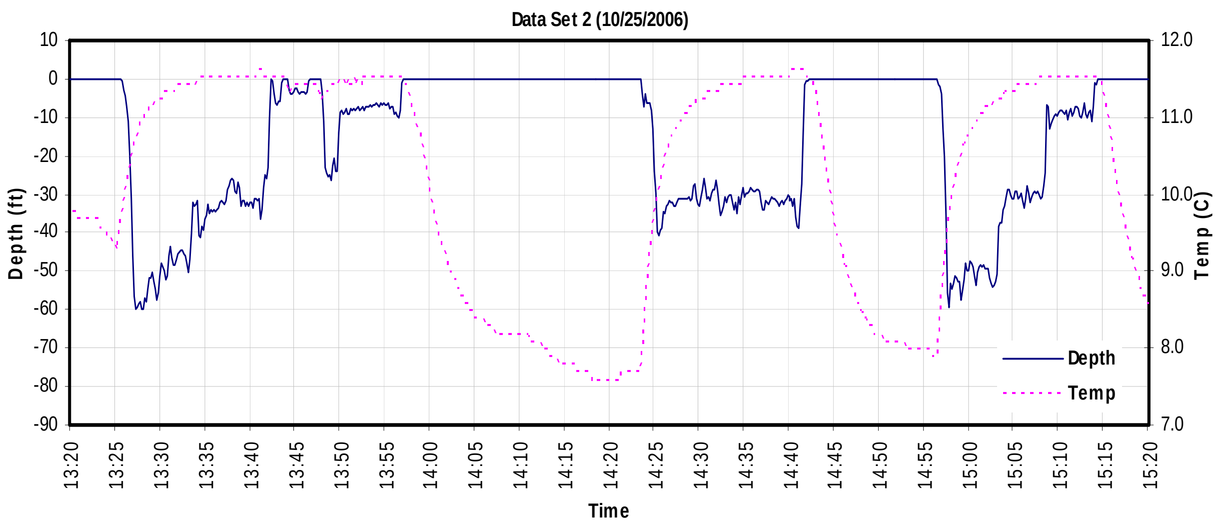


Figure 6. HOBO water level logger output from the October 25, 2006 sampling





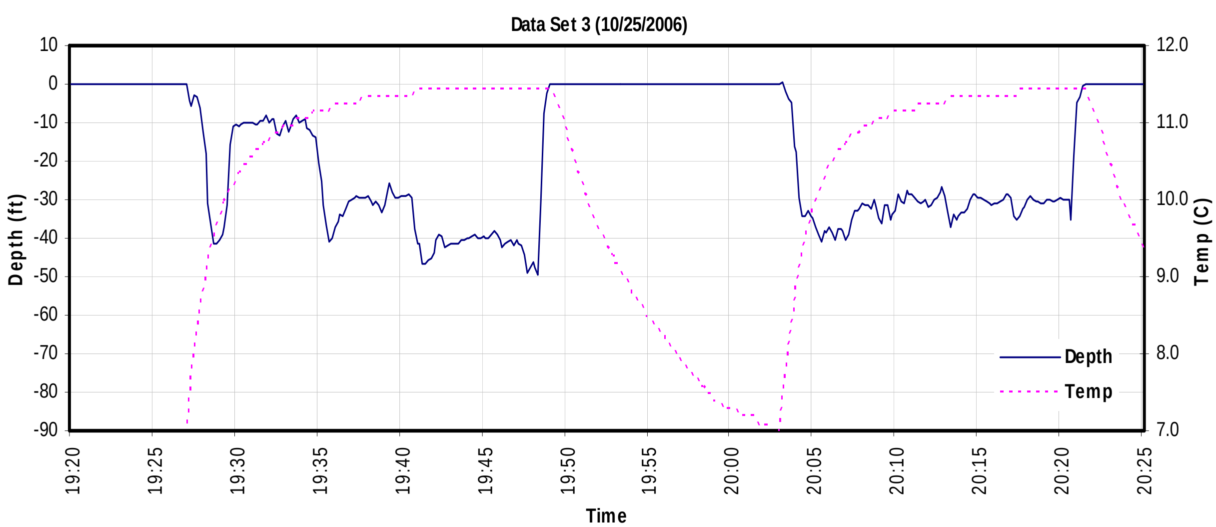


Table 1. Ichthyoplankton sampling data for October 25, 2006 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Mill Cove Ichthyoplankton sampling
25 October 2006
Oblique tows to current direction (75cm diameter net) -

Tow Type	Mean Depth (YSI sonde depth @ ~1-2 ft above net, m/ft)	Mean Depth (sensor on net, (m/ft)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count diff	Temp (ºC)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM Low water															
Target depth	8.9 / 29.3	9.5 / 32.9	0823	0839	16	1.5-1.9	7225	32636	**25411**	11.6	31.5	682.9	71.1	1.4	**301.5**
Composite															
bottom	13.0 / 42.8	12.9 / 42.4	0851	0856	5	1.6-1.8	32636	--------		11.7	31.8				
target	9.6 / 31.4	10.1 / 33.3	0857	0903	6	1.8-2.0	--------	--------		11.7	31.6				
surface	1.4 / 4.6	1.8 / 6.0	0905	0910	5	1.7-1.9	--------	57970	**25334**	11.6	30.6	680.8	70.9	1.4	**300.6**
PM High water															
Composite															
bottom	14.3 / 47.0	14.0 / 45.8	1331	1336	5	1.4-1.9	57970	--------		11.7	32.2				
target	9.4 / 30.8	9.4 / 31.0	1337	1343	6	1.4-1.9	--------	--------		11.7	32.0				
surface	1.7 / 5.7	2.3 / 7.7	1352	1358	6	1.4-1.9	--------	85844	**27874**	11.6	31.4	749.1	73.4	1.4	**330.8**
Target depth	No data	9.5 / 31.4	1428	1443	15	1.4-1.1	85844	109243	**23399**	No data		628.8	69.9	1.3	**277.7**
Night Low water	***Est. depth from real-time YSI***														
Composite															
surface	*2.2 / 7.5*	3.1 / 10.3	1932	1937	5	1.0-1.7	109375	--------		No data					
target	*8.8 / 29.0*	9.0 / 29.7	1938	1943	5	1.1-1.8	--------	--------		No data					
bottom	*12.2 / 40.0*	12.3 / 40.4	1945	1950	5	1.1-1.6	--------	130741	**21366**	No data		574.2	63.8	1.2	**253.5**
Target depth	*9.5 / 31.2*	9.5 / 31.3	2008	2023	15	1.2-1.9	130741	151589	**20848**	No data		560.2	62.2	1.2	**247.4**
											Mean	**646.0**	**68.6**	**1.3**	**285.2**

Table 2. Analysis results of October 25, 2006 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton vol. (ml)	Species (scientific)	# in sample	Species (common)
high water target depth	8			
low water target depth	6			
night low water target depth	30	*Clupea harengus*	35 larvae	Herring
high water multi-depth composite	7	*Enchelyopus cimbrius*	1 egg	Four-beard rockling
low water multi-depth composite	10	*Clupea harengus*	2 larvae	Herring
night low water multi-depth composite	23	*Clupea harengus*	29 larvae	Herring
		Enchelyopus cimbrius	1 larva	Four-beard rockling
		Scophthalmus aquosus	1 larva*	Windowpane flounder

* (juvenile on data sheet because migrating eye was on dorsal midline of head)

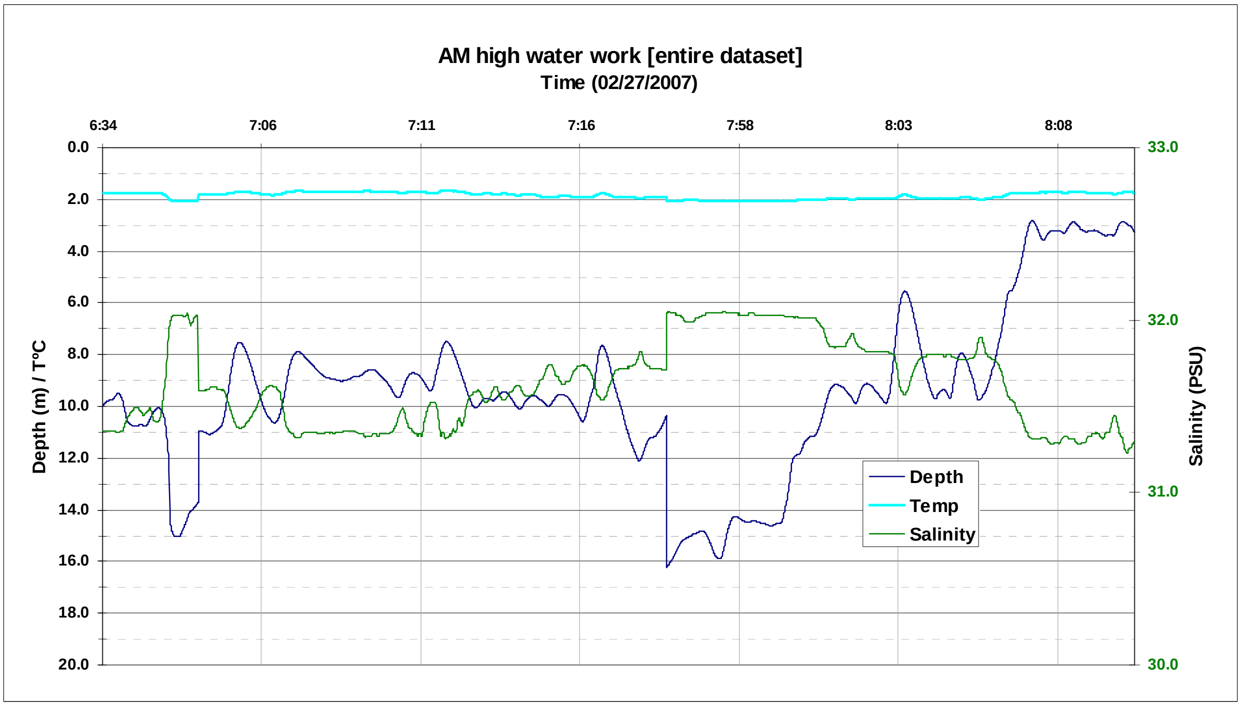
Summary

		Eggs	Larvae	m^3	Eggs #/m^3	Larvae #/m^3
PM HW target depth		0	0	277.7	0.000	0.000
AM LW target depth		0	0	301.5	0.000	0.000
Night LW target depth	*Clupea harengus*	0	35	247.4	0.000	**0.141**
PM HW multi-depth composite		1	0	330.8	0.003	0.000
AM LW multi-depth composite	*Clupea harengus*	0	2	300.6	0.000	0.007
Night LW multi-depth composite	*Clupea harengus*	0	29	253.5	0.000	**0.114**
	Enchelyopus cimbrius	0	1	253.5	0.000	0.004
	Scophthalmus aquosus	0	1	253.5	0.000	0.004
			Means	**285.3**	**0.001**	**0.045**

Fish larvae				
Common name	**Scientific name**	**AM LW**	**PM HW**	**Night**
Atlantic herring	*Clupea harengus*	**0.003**	**0.000**	**0.128**
Four-beard rockling	*Enchelyopus cimbrius*	**0.000**	**0.000**	**0.002**
Windowpane flounder	*Scophthalmus aquosus*	**0.000**	**0.000**	**0.002**

Larvae loss in fall			Equivalent adult loss 1:100,000	1:10,000	1:1,000
Target loss	**0.047**	**453,635**	**4.54**	**45.4**	**454**
Daily mean	**0.045**	**433,546**	**4.34**	**43.4**	**434**

Figure 7. YSI 6600 output from the AM LW and PM HW February 27, 2007 samplings



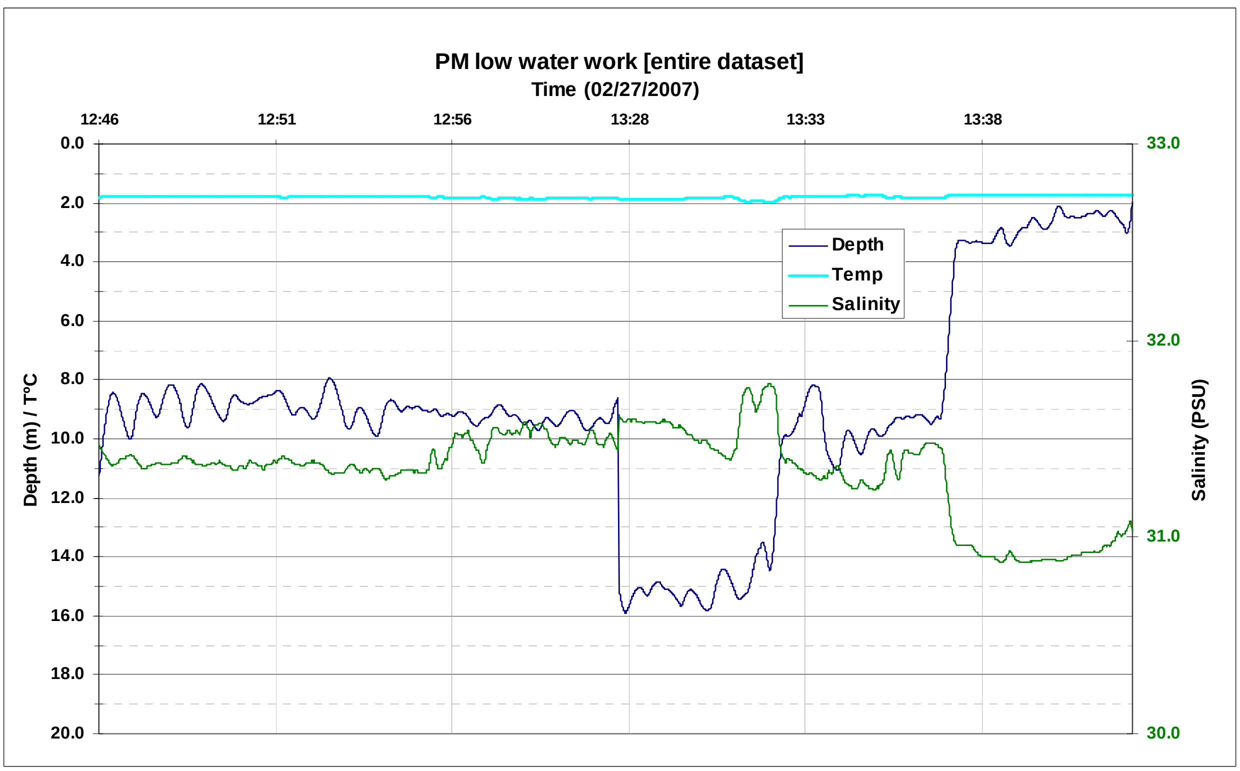
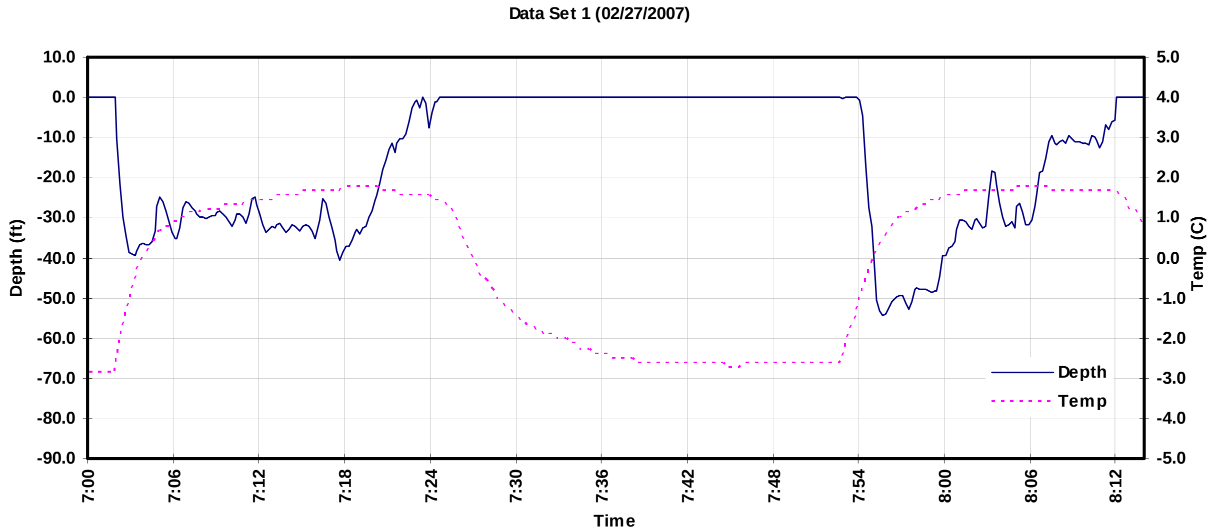
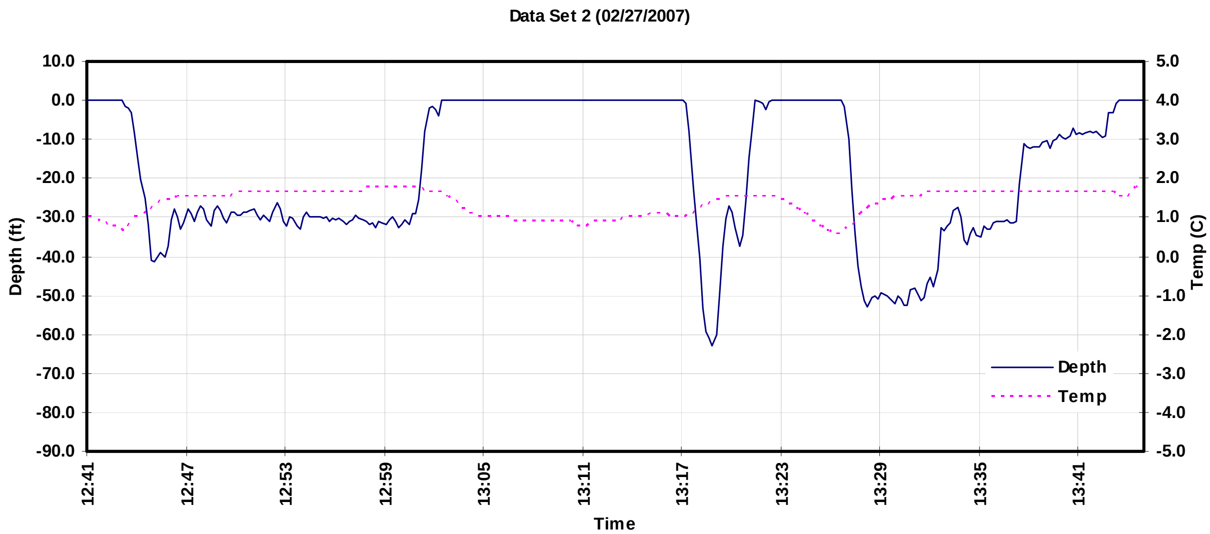


Figure 8. HOBO water level logger output from the February 27, 2007 sampling





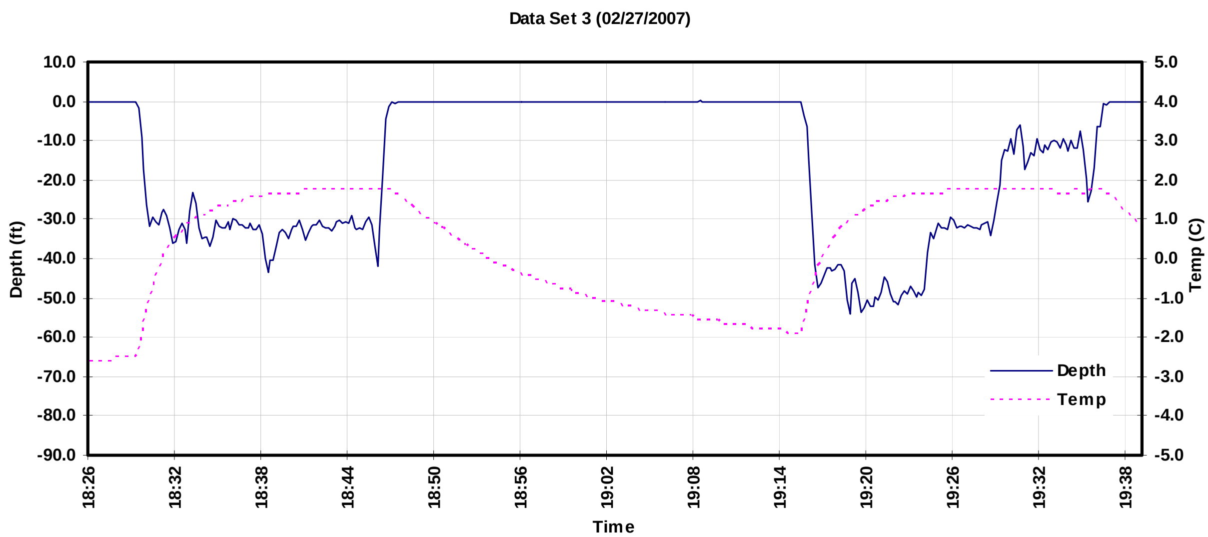


Table 3. Ichthyoplankton sampling data for February 27, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Mill Cove Ichthyoplankton sampling
27 February 2007
Oblique tows to current direction (61cm diameter net)

Tow Type	Mean Depth (YSI sonde depth @ ~1-2 ft above net, m/ft)	Mean Depth (sensor on net, (m/ft)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count diff	Temp (ºC)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM High water															
Target depth	9.4 / 31.0	32.9 / 10.0	0704	0719	15	1.5-1.9	20808	51025	**30217**	1.8	31.5	812.0	90.2	1.7	**237.2**
Composite															
bottom	13.6 / 44.7	48.7 / 14.8	0756	0801	5	1.6-1.8	51025	--------		2.0	32.0				
target	8.7 / 28.6	30.2 / 9.2	0801	0806	5	1.8-2.0	--------	--------		1.9	31.8				
surface	3.7 / 12.2	14.6 / 4.4	0806	0811	5	1.7-1.9	--------	76040	**25015**	1.8	31.4	672.2	74.7	1.4	**196.4**
PM Low water															
Target depth	9.1 / 29.7	31.9 / 9.7	1428	1443	15	1.4-1.1	76020	99570	**23550**	1.8	31.4	632.9	70.3	1.4	**184.9**
Composite															
bottom	15.2 / 50.0	50.8 / 15.5	1327	1332	5	1.4-1.9	99570	--------		1.8	31.5				
target	10.2 / 33.4	33.2 / 10.1	1334	1337	5	1.4-1.9	--------	--------		1.8	31.4				
surface	3.0 / 9.9	11.2 / 3.4	1338	1343	5	1.4-1.9	--------	121852	**22282**	1.7	30.9	598.8	66.5	1.3	**174.9**
Night High water															
Target depth	9.8 / 32.2	33.3 / 10.1	1832	1846	14	1.2-1.9	121826	144174	**22348**	2.0	31.8	600.6	71.5	1.4	**175.4**
Composite															
bottom	14.8 / 48.5	48.9 / 14.9	1919	1924	5	1.0-1.7	144174	--------		2.0	32.0				
target	9.6 / 31.6	33.0 / 10.0	1924	1930	6	1.1-1.8	--------	--------		1.9	31.7				
surface	3.9 / 12.9	12.5 / 3.8	1930	1935	5	1.1-1.6	--------	176196	**32022**	1.8	31.4	860.5	89.6	1.7	**251.4**
											Mean	**696.2**	**77.1**	**1.5**	**203.3**

Table 4. Analysis results of February 27, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton vol. (ml)	Fish species (scientific name)	# in sample	Fish species (common name)	#/m^3
AM HW target depth	5	*Ammodytes sp.*	1	Sand lance	**0.004**
		Myoxocephalus octodecemspinosus	2	Longhorn sculpin	**0.008**
		Liparis inquilinus	1	Sea snail	**0.004**
		Lumpenus lampretaeformis	7	Snake blenny	**0.030**
		CHW (cod/haddock/witch flounder)? eggs	1		**0.004**
			11	**Larvae/m^3**	**0.046**
AM HW composite	5	*Myoxocephalus octodecemspinosus*	1	Longhorn sculpin	**0.005**
		Lumpenus lampretaeformis	7	Snake blenny	**0.036**
		Clupea harengus? eggs	1	Herring	**0.005**
			8	**Larvae/m^3**	**0.041**
PM LW target depth	4	*Melanogrammus aeglefinus*	2	Haddock	**0.011**
		Myoxocephalus octodecemspinosus	1	Longhorn sculpin	**0.005**
		Ammodytes sp.	1	Sand lance	**0.005**
		Lumpenus lampretaeformis	12	Snake blenny	**0.065**
			16	**Larvae/m^3**	**0.087**
PM LW composite	6	*Ammodytes* sp.	4	Sand lance	**0.023**
		Myoxocephalus octodecemspinosus	3	Longhorn sculpin	**0.017**
		Triglops sp.	1	Sculpin	**0.006**
		Lumpenus lampretaeformis	19	Snake blenny	**0.109**
		Lumpenus sp.	1	Snake blenny	**0.006**
		unidentifiable	1		**0.006**
		Clupea harengus? eggs	1	Herring	**0.006**
			29	**Larvae/m^3**	**0.166**
Night HW target depth	5	*Melanogrammus aeglefinus*	1	Haddock	**0.006**
		Lumpenus lampretaeformis	4	Snake blenny	**0.023**
			5	**Larvae/m^3**	**0.029**
Night HW composite	15	*Ammodytes* sp.	1	Sand lance	**0.004**
		Triglops sp.	1	Sculpin (Mailed sculpin)	**0.004**
		Myoxocephalus octodecemspinosus	1	Longhorn sculpin	**0.004**
		Liparis inquilinus	1	Sea snail	**0.004**
		Lumpenus lampretaeformis	22	Snake blenny	**0.088**
		CHW (cod/haddock/witch flounder)? eggs	1		**0.004**
		Clupea harengus? eggs	1	Herring	**0.004**
			26	**Larvae/m^3**	**0.103**

Table 4. Analysis results of February 27, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine. (Continued)

Summary

	Eggs	Larvae	m^3	Eggs #/m^3	Larvae #/m^3
AM HW target depth	1	11	237.2	0.004	0.046
AM HW composite	1	8	196.4	0.005	0.041
PM LW target depth	0	16	184.9	0.000	0.087
PM LW composite	1	29	174.9	0.006	**0.166**
Night HW target depth	0	5	175.4	0.000	0.029
Night HW composite	2	26	251.4	0.008	**0.103**
		Means	**203.3**	**0.004**	**0.079**

Larvae loss in winter			Equivalent adult loss 1:100,000	Equivalent adult loss 1:10,000	Equivalent adult loss 1:1,000
Target loss	**0.054**	**517,640**	**5.18**	**51.8**	**518**
Daily mean	**0.079**	**755,812**	**7.56**	**75.6**	**756**

Table 5. Zooplankton Analysis of February 27, 2007 samples by Dr. Ray Gerber, Brunswick, Maine

Species List	Numbers per Sample					
	AM High Water Multi-depth	AM High Water Target Depth	PM Low Water Multi-depth	PM Low Water Target Depth	Night High Water Multi-depth	Night High Water Target Depth
Calanoid Copepods:						
Acartia hudsonica	1,153	987	14,434	17,200	23,192	10,219
Acartia longiremis						
Acartia tonsa						
Calanus finmarchicus	1,557	1,343	2,226	2,167	3,571	3,223
Calanus hyperboreus		18			27	8
Centropages hamatus						
Centropages typicus	30	12	21	13	11	11
Centropages spp.						
Eurytemora herdmani		3	621	495	64	75
Metrida longa			11		13	
Metridia lucens	24	30	32	40	134	80
Microcalanus pusillus						
Paracalanus parvus	37	6	32	27	16	5
Pseudocalanus spp.	422	244	439	776	776	348
Scolethcithricella minor	6				11	8
Temora longicornis	24		235	120	21	16
Tortanus discaudatus			11			
Cyclopoid Copepods:						
Oithonia atlantica		24				
Oithonia similis						
Monstrilloid Copepods				1		27
Harpacticoid Copepods						
Cladocera:						
Evadne nordmanni						
Pleopis polyphemoides						
Euphausiids:						
Megayctiphanes norvegica		1	1		1	11
Thysanoessa inermis	1				1	
Cumaceans					27	32
Amphipods					10	5
Mysids					1	
Decapods (Carideans)						1
Crustacea larvae:						
Cypris larvae						
Decapod larvae	18	12	43	54	16	16
Nauplii	12	6				5
Zoea (Brachyura)	6					

Table 5. Zooplankton Analysis of February 27, 2007 samples by Dr. Ray Gerber, Brunswick, Maine (Cont.)

Gastropod mollusks:							
Veliger larvae	18		11	67	5	21	
Polychaetes:							
Polychaete larvae	6						
Tomopterus sp.							
Echinoderms:							
Pluteus larvae							
Medusae	6		139	13	10	32	
Chaetognaths:							
Parasagitta elegans		3		1	2		
Larvacea:							
Fritillaria borealis					5		
Oikopleura dioica							
Ascidian larvae	18	6	21	27	5	11	
Total	**3,338**	**2,695**	**18,277**	**21,001**	**27,919**	**14,154**	
m^3 sampled	237.2	196.4	184.9	174.9	175.4	251.4	**Mean #/m^3**
#/m^3	**14**	**14**	**99**	**120**	**159**	**56**	**77**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine 02/27/07

General Comments:

Prior to sub-sampling the larger sized organisms were picked out and identified.
Sub-samples used for analysis included 3 to 6 - 2 ml aliquots of the samples. All the organisms in each subsample were identified and counted. The samples were thoroughly mixed prior to and during the subsamplings. In most cases the counts for the identified species combined the immature and mature stages. The list of species in the table contains the common species of zooplankton which is known to occur in Passamaquoddy Bay throughout a season. Therefore, a particular sample would not be expected to contain all the species in the list.

In the February samples the abundance of nearly all the zooplankton was much lower than in the spring (05/28/07) samples and the adult stages out numbered the immature stages. The immature stages far out numbered the adults in the spring samples. The February samples contained mostly holo-zooplankton and very little mero-zooplankton (larval stages of benthic organisms).

The sample called "AM High Water Target Depth" contained sediment particles and small benthic polychaetes and oligochaetes along with the zooplankton. Apparently the nets touched bottom. This may explain the low abundance of the zooplankton observed in this sample.

Specific Comments:

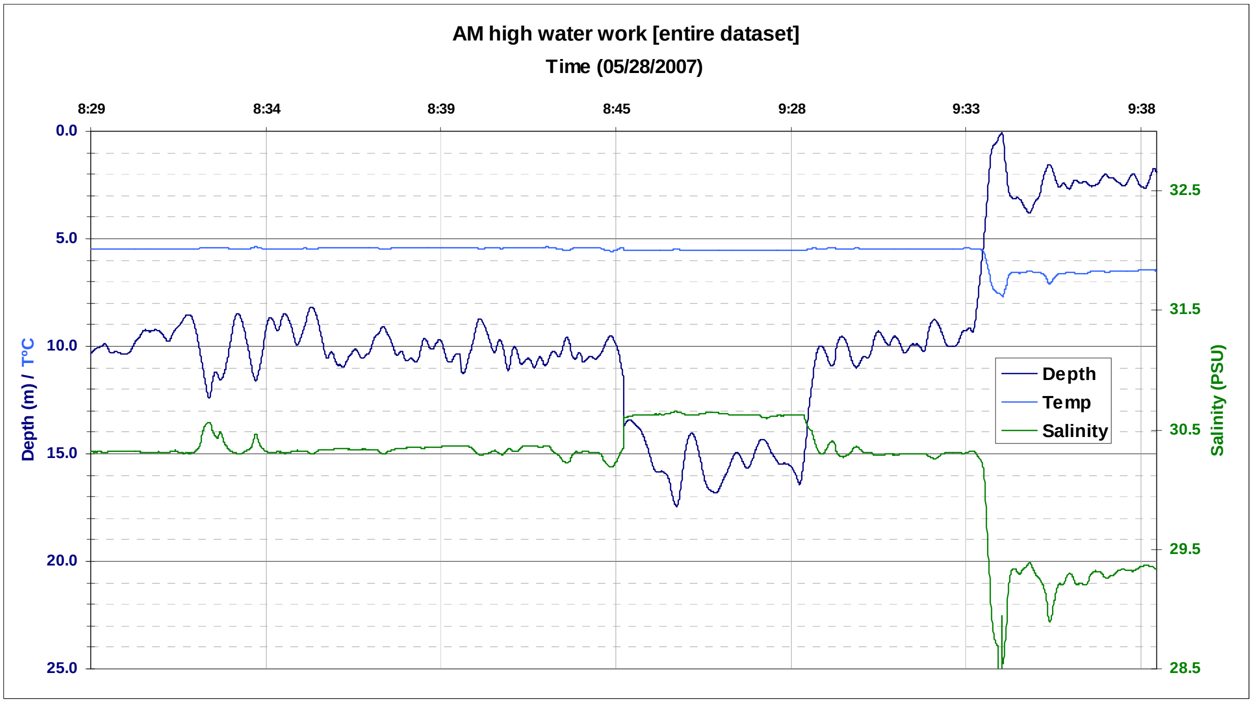
Pseudocalanus spp.
It was confirmed that both *Pseudocalanus* species (*P. moultoni* and *P. neumani*) occurred in the 02/27/07 samples from Mill Cove and that *P. moultoni* is the more abundant of the two.

Medusae
In contrast to the spring Mill Cove samples (05/28/07) the abundance of medusae was much lower. The few medusae that were present did not consist of *Obelia* sp. which was so abundant in the spring samples.

Calanus hyperboreaus, Scolecithricella minor and Euphausiids
The presence of these holo-zooplankton in the February samples indicates that cold ocean water from the Bay of Fundy and Gulf of Maine is entering Passamaquoddy Bay.

Amphipods, Cumaceans and Mysids
These crustacea are all of the benthic or epibenthic varieties and are not true zooplankton. They appeared only in the two night samples (Night High Water Target Depth and Night High Water Multi-depth Composite) where they were sampled in the water column.

Figure 9. YSI 6600 output from the AM LW and PM HW May 28, 2007 samplings



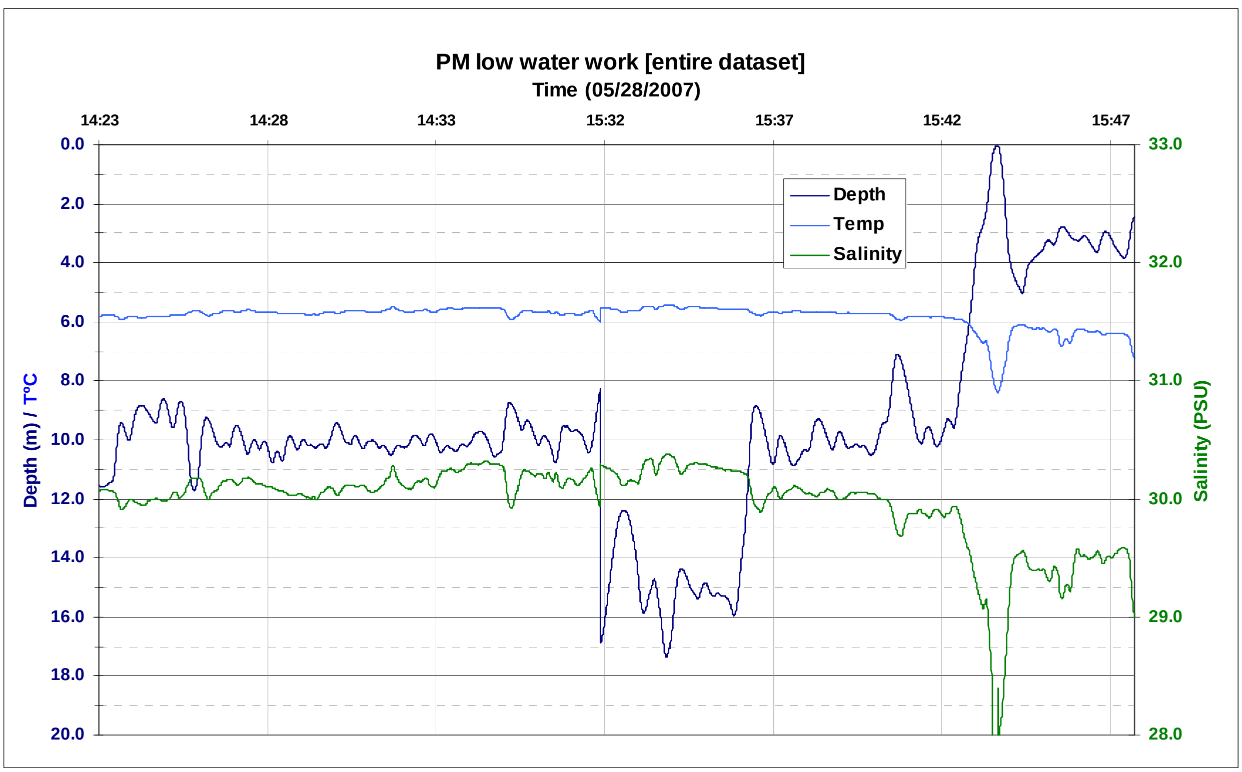


Figure 9. YSI 6600 output from the AM LW and PM HW May 28, 2007 samplings (Cont.)

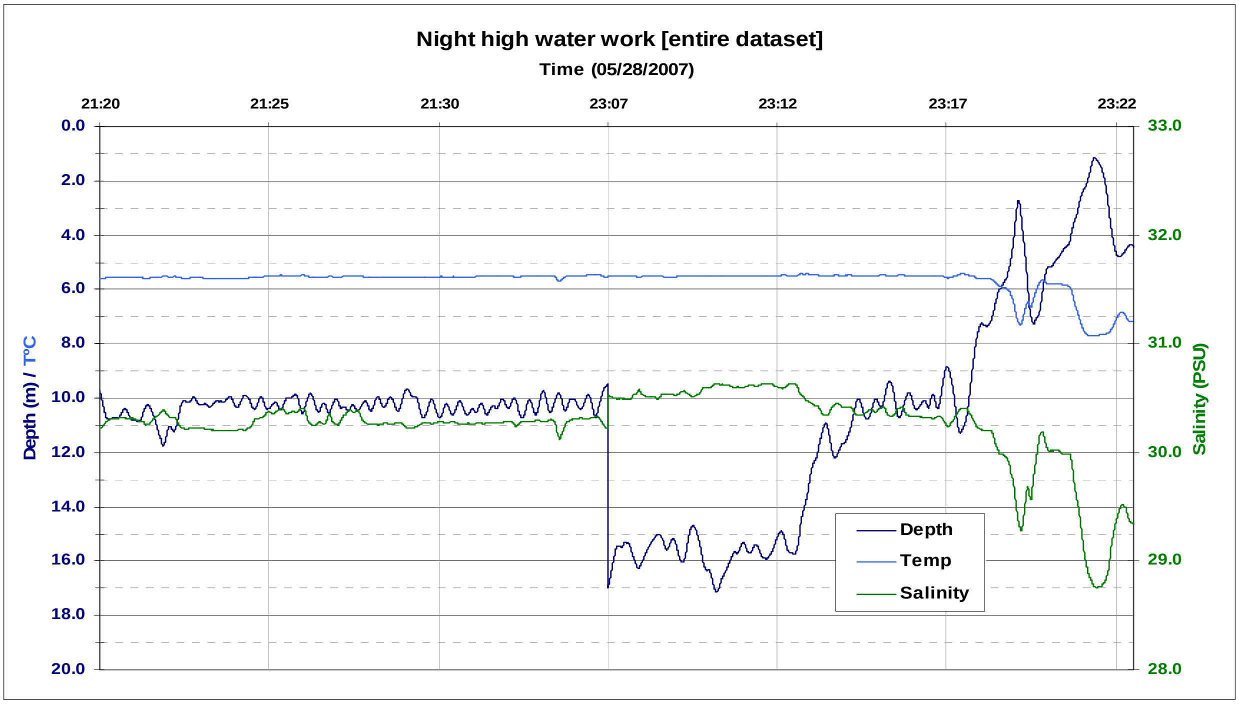
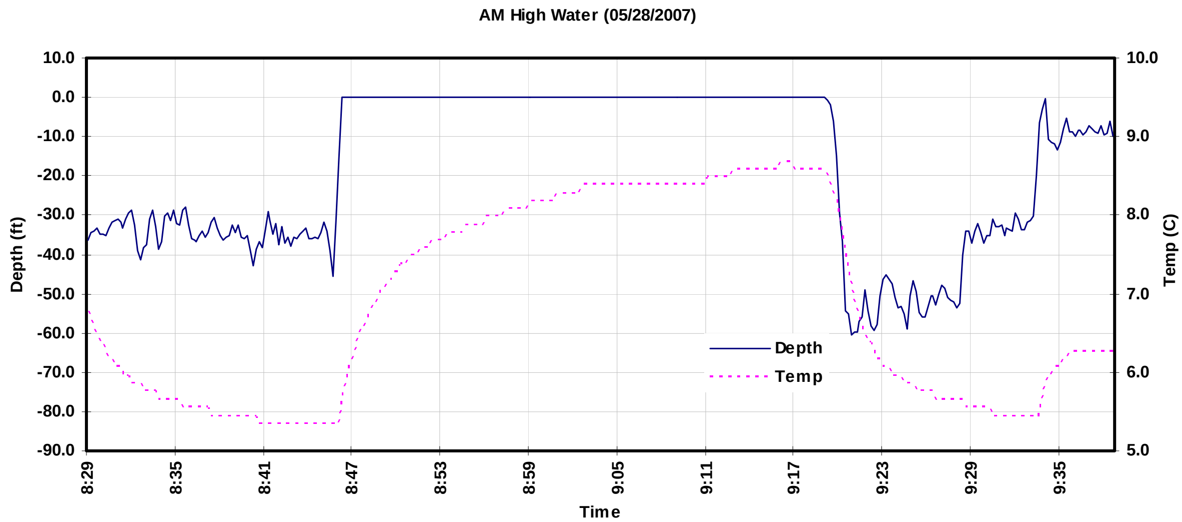
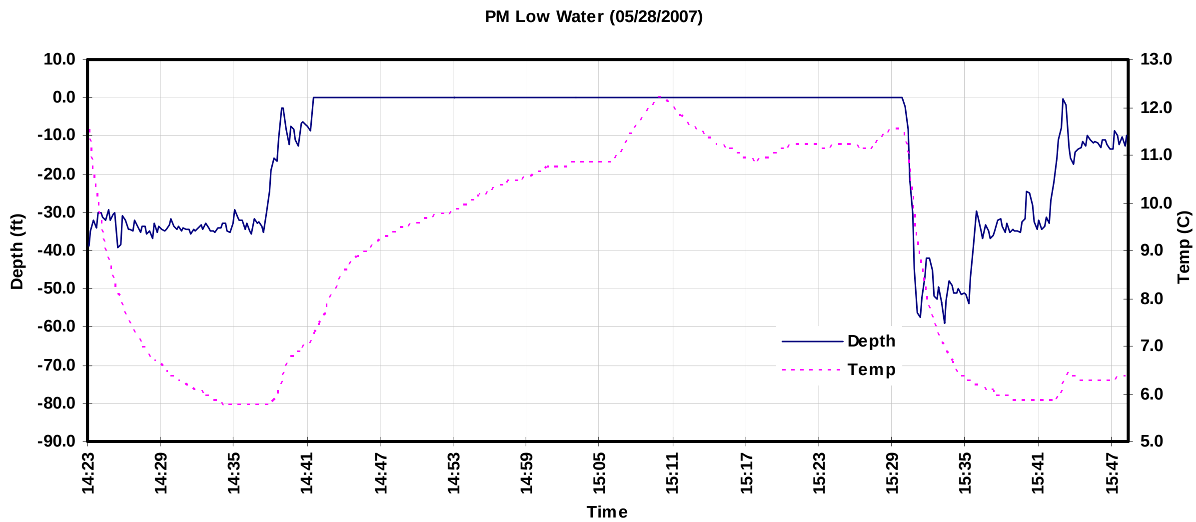


Figure 10. HOBO water level logger output from the May 28, 2006 sampling





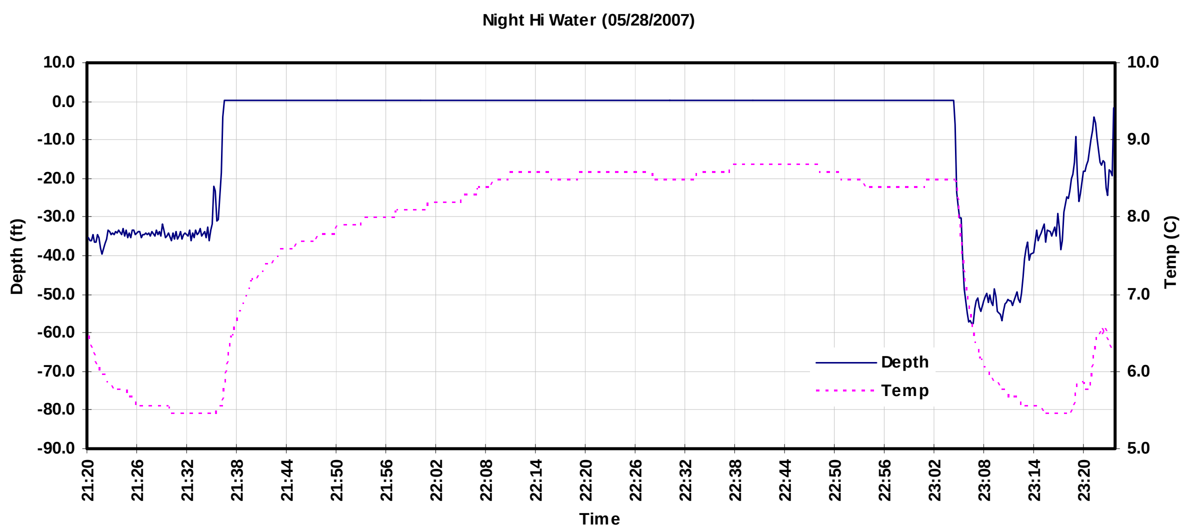


Table 6. Ichthyoplankton sampling data for May 28, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

DE LNG Ichthyoplankton/zooplankton sampling
28 May 2007
Oblique tows to current direction

Tow Type	Mean Depth (YSI sonde depth @ ~3 ft above net)	Mean Depth (sensor on net, ft/m)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count difference	Temp (ºC)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM High water															
Target depth	33.9/10.3	34.1/10.4	0829	0846	15	/	187535	204796	**17261**	5.5	30.3	463.9	51.5	1.0	**135.5**
Composite															
bottom	50.0/15.2	51.7/15.7	0923	0928	5	/	204796	--------		5.5	30.6				
target	31.8/9.7	33.1/10.1	0928	0933	5	/	--------	--------		5.5	30.3				
surface	7.7/2.3	8.4/2.6	0933	0938	5	/	--------	223220	**18424**	6.8	28.3	495.1	55.0	1.1	**144.6**
PM Low water															
Target depth	32.8/10.0	33.5/10.2	1423	1438	15	/	223225	247911	**24686**	5.7	30.1	663.4	73.7	1.4	**193.8**
Composite															
bottom	49.2/15.0	49.4/15.0	1532	1537	5	/	247911	--------		5.5	30.3				
target	32.0/9.8	32.8/10.0	1537	1542	5	/	--------	--------		5.7	30.0				
surface	10.8/3.3	11.2/3.4	1543	1548	5	/	--------	274625	**26714**	6.6	28	717.9	79.8	1.5	**209.7**
Night High water															
Target depth	33.9/10.3	34.6/10.5	2120	2135	15	/	274625	296117	**21492**	5.5	30.3	577.6	64.2	1.2	**168.7**
Composite															
bottom	51.5/15.7	51.9/15.8	2307	2312	5	/	296117	--------		5.5	30.6				
target	35.4/10.8	38.5/11.7	2312	2316	5	/	--------	--------		6	30.5				
surface	15.6/4.7	19.0/5.8	2316	2322	6	/	--------	321831	**25714**	6.5	29.7	691.0	72.0	1.4	**201.8**
											Mean	**601.5**	**66.0**	**1.3**	**175.7**

Table 7. Analysis results of May 28, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
AM HW	20	*Mallotus villosus*	1		**0.007**
		unidentifiable	1		**0.007**
		Pseudopleuronectes americanus	1		**0.007**
		Total	**3**	**Larvae/m^3**	**0.022**
		H4B eggs	19		**0.140**
		Enchelyopus cimbrius eggs	2		**0.015**
		Total	**21**	**Eggs/m^3**	**0.155**
AM HW comp.	15	*Pseudopleuronectes americanus*	**4**	**Larvae/m^3**	**0.028**
		H4B eggs	7		**0.036**
		CHW eggs	1		**0.005**
		Total	**8**	**Eggs/m^3**	**0.055**
PM LW target	32	*Liparis inquilinus*	3		**0.015**
		Myoxocephalus aenaeus	2		**0.010**
		unidentifiable	1		**0.005**
		Pseudopleuronectes americanus	25		**0.129**
		H4B eggs	16		**0.083**
		Total	**47**	**Larvae/m^3**	**0.243**
		Enchelyopus cimbrius eggs	2		**0.010**
		CHW eggs	1		**0.005**
			3	**Eggs/m^3**	**0.015**
PM LW comp.	16	*Mallotus villosus*	1		**0.005**
		Liparis inquilinus	2		**0.010**
		Myoxocephalus aenaeus	1		**0.005**
		Pholis gunnellus	1		**0.005**
		Liparis atlanticus	1		**0.005**
		Pseudopleuronectes americanus	40		**0.191**
		Total	**46**	**Larvae/m^3**	**0.219**
		H4B eggs	7		**0.033**
		Enchelyopus cimbrius eggs	3		**0.014**
		Gadus morhua eggs	1		**0.005**
		Total	**11**	**Eggs/m^3**	**0.052**
Night HW target	128	*Myoxocephalus aenaeus*	1		**0.006**
		Pseudopleuronectes americanus	3		**0.018**
		Total	**4**	**Larvae/m^3**	**0.024**

Table 7. Analysis results of May 28, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine. (Cont.)

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
		H4B eggs	20		**0.119**
		Enchelyopus cimbrius eggs	2		**0.012**
		Gadus morhua eggs	1		**0.006**
		Total	**23**	**Eggs/m^3**	**0.136**
Night HW comp	52	*Liparis inquilinus*	1		**0.005**
		Myoxocephalus aenaeus	2		**0.010**
		Pholis gunnellus	2		**0.010**
		Pseudopleuronectes americanus	24		**0.119**
		Total	**29**	**Larvae/m^3**	**0.144**
		H4B eggs	17		**0.084**
		Enchelyopus cimbrius eggs	4		**0.020**
		Gadus morhua eggs	1		**0.005**
		Total	**22**	**Eggs/m^3**	**0.109**

	Eggs	Larvae	m^3	Eggs #/m^3	Larvae #/m^3
AM HW target	21	3	135.5	0.155	0.022
AM HW comp	8	4	144.6	0.055	0.028
PM LW target	3	47	193.8	0.015	0.243
PM LW comp	11	46	209.7	0.052	**0.219**
Night HW target	4	23	168.7	0.024	0.136
Night HW comp.	22	29	201.8	0.109	**0.144**
		Mean	**175.7**	**0.068**	**0.132**

	Larvae loss/spring [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.134**	**1,285,910**	**12.86**	**128.6**	**1286**
Daily mean	**0.132**	**1,269,358**	**12.69**	**126.9**	**1269**

	Egg loss/spring [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.065**	**622,660**	**6.23**	**62.3**	**623**
Daily mean	**0.068**	**658,872**	**6.59**	**65.9**	**659**

[1] **Assumes 45.5 vessel visits per winter/spring**

Table 8. Zooplankton Analysis of May 28, 2007 samples by Dr. Ray Gerber, Brunswick, Maine

	Numbers per Sample						
Species List	**AM High Water Multi-depth**	**AM High Water Target Depth**	**PM Low Water Multi-depth**	**PM Low Water Target Depth**	**Night High Water Multi-depth**	**Night High Water Target Depth**	
Calanoid Copepods:							
Acartia hudsonica	181,440	124,032	89,910	68,310	148,436	181,116	
Acartia longiremis							
Acartia tonsa							
Calanus finmarchicus	1,296	2,312	702	1,215	4,644	4,816	
Centropages hamatus		68					
Centropages typicus							
Centropages spp.					172		
Eurytemora herdmani	432	1,700	6,858	5,940	3,268	5,332	
Metridia lucens						344	
Microcalanus pusillus						516	
Pseudocalanus spp.	1,944	3,876	10,314	15,714	9,632	7,740	
Temora longicornis	216	884	1,242	702	860	1,720	
Tortanus discaudatus	40,176	72,080	62,000	41,310	48,848	36,808	
Cyclopoid Copepods:							
Oithonia atlantica							
Oithonia similis							
Harpacticoid Copepods	432	408	378	513	172	172	
Cladocera:							
Evadne nordmanni	144		81	189	172		
Pleopis polyphemoides	144		135	81			
Crustacea larvae:							
Cypris larvae	900	1,700	5,481	4,725	3,096	2,752	
Decapod larvae	1,584	3,808	2,268	1,323	1,892	688	
Nauplii	86,184	162,384	68,040	106,920	104,060	58,996	
Zoea (Brachyura)							
Parasitic copepods						172	
Parasitic isopods				27			
Gastropod mollusks:							
Veliger larvae	72	408	351	405	688	860	
Polychaetes:							
Polychaete larvae		2,312	1,080	486	9,804	18,232	
Tomopterus sp.		68	27				
Echinoderms:							
Pluteus larvae					688	1,892	
Medusae:	46,008	102,884	28,350	30,240	123,668	89,784	
Chaetognaths:							
Parasagitta elegans	180	544	1,458	351	1,548	1,892	
Larvacea:							
Fritillaria borealis	8,424	7,888	4,590	3,240	57,964	60,372	
Oikopleura dioica							
Ascidian larvae				54			
Sample total	**369,576**	**487,356**	**283,265**	**281,745**	**519,612**	**474,204**	
m^3 sampled	144.6	135.5	209.7	193.8	201.8	168.7	**Mean #/m^3**
#/m^3	**2556**	**3597**	**1351**	**1454**	**2575**	**2811**	**2390**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine 05/28/07

General Comments:

Subsamples used for analysis included 3 - 2 ml aliquots of the samples and all the organisms in each subsample were identified and counted. The samples were thoroughly mixed prior to and during the subsamplings. In most cases the counts for the identified species combined the immature and mature stages. Usually, the immature stages far out numbered the adults.

The list of species in the table contains the common species of zooplankton which is known to occur in Passamaquoddy Bay throughout a season. Therefore, a particular sample would not be expected to contain all the species in the list.

The samples from Mill Cove contain a mix of holozooplankton and merozooplankton. Holozooplankton spend their entire life cycle in the water column. They include calanoid and cyclopoid copepods, cladocera, chaetognaths, most medusae and larvacea. Merozooplankton are the immature stages of benthic organisms that for a time live in the water column. This group consists of the larvae and early developmental stages of crustacea (crabs, shrimp, barnacles, lobsters, etc.), gastropods (and other mollusks), polychaete worms, echinoderms (sea stars and sea urchins) and ascidian larvae (sea-squirt tunicates).

All six samples from Mill Cove contained substantial quantities of bright orange, irregularly shaped, egg-like objects. Dissection of these eggs revealed that they contained embryos which appeared very similar to those of Actiniaria (sea anemones). Many of these eggs were damaged. They were floating on top of the liquid and lying on the bottom of the sample jar. It was not possible to reliability subsample these for enumeration.

Two of the samples (Night High Water Target Depth and Night High Water Multi-depth Composite) contained large amounts of diatom chains. Apparently, these plankton tows sampled water that contained an intense phytoplankton bloom.

Specific Comments:

Centropages spp.
In the above species list *Centropages* spp., represents immature stages (copepodites) that could not be assigned to the two known species that occur in Passamaquoddy Bay.

Pseudocalanus spp.
Two species of the copepod genus, *Pseudocalanus*, occur along the Maine coast. They consist of *P. neumani* and *P. moultoni*. They are similar morphologically and can not be accurately identified to species using a dissecting microscope. Each can be identified using a compound microscope to observe minute features that separate the two species. Since this was not practical for the present study the counts for both species are listed as *Pseudocalanus* spp. In addition, there is no reliable method to distinguish between the developmental stages (copepodites) of the two species. I did confirm that both species do occur in the samples from Mill Cove and that *P. moultoni* is the more abundant of the two.

Medusae
Medusae are very delicate organisms that become damaged when collected with standard zooplankton nets and from subsequent handling of the samples. Also, when preserved in formalin medusae become misshapen e.g., turn inside out. This makes routine identifications difficult. In the present study medusae were not identified to species. However, in the samples from Mill Cove a species of *Obelia* appeared to be the most abundant medusa and a few individuals of *Rathka octopuntata* were identified.

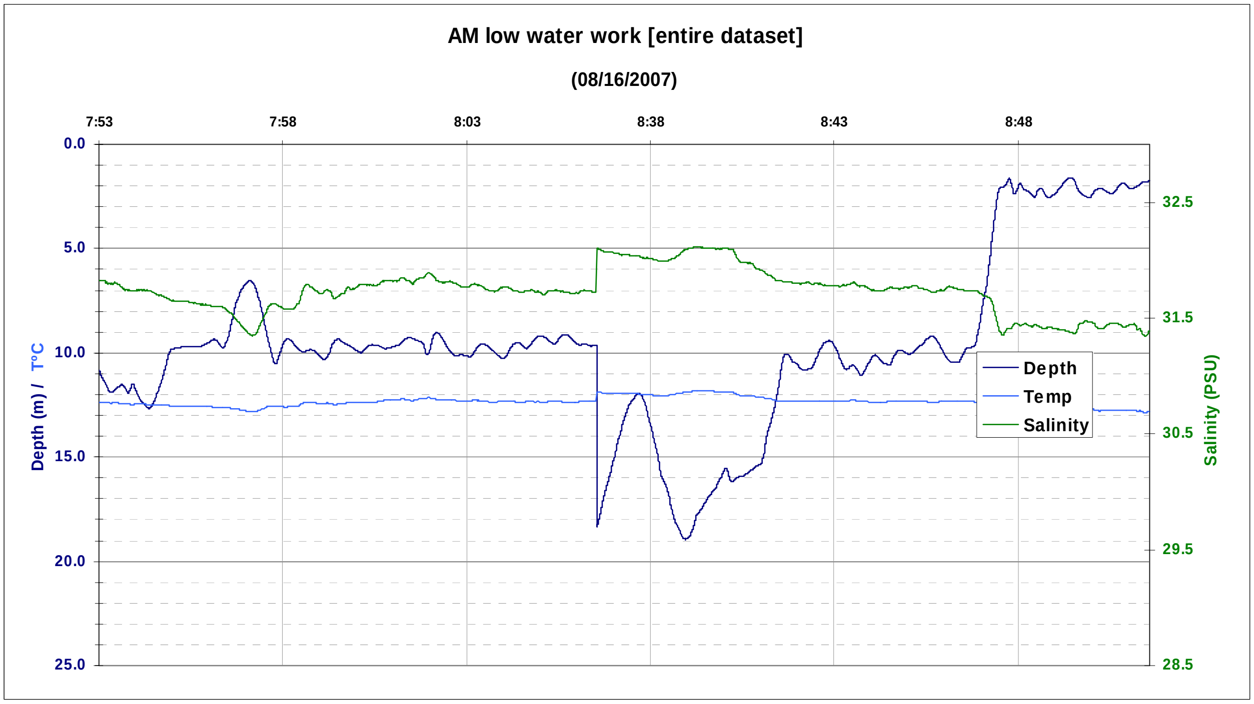
Crustacea larvae
This main group contains a mix of holozooplankton and merozooplankton crustacean larvae.

Cypris larvae
Cypris larvae are the last planktonic developmental stage of cirripedes- barnacles (*e.g. Semibalanus balanus*) before settling out of the water column.

Nauplii
Nauplii represent the first stage of development upon hatching from the egg in many crustacea including copepods, barnacles, mysid shrimp and euphausiids (krill). This stage has no segmentation of the body and swim by using its antennae. For the samples from Mill Cove all types of nauplii were combined as one group.

Decapod larvae and Zoea (Brachyura)
Most decapod crustacea, which include benthic and planktonic caridean shrimp, lobsters and crabs, lack the nauplius stage. Instead, they hatch out in the zoea stage or protozoea stage having a partially segmented thorax and long abdomen. After several zoea stages the thorax becomes clearly segmented and the main divisions of the body become evident. At this point the decapod larvae are known as the zoea-mysis stage. For the samples from Mill Cove all the zoea and zoea-mysis stages were combined under the heading Decapod larvae. However, the zoea and megalopa stages of brachyura (crabs) are very distinct and will be enumerated separately when present in the samples.

Figure 11. YSI 6600 output from the AM LW PM HW and Night LW August 16, 2007 samplings



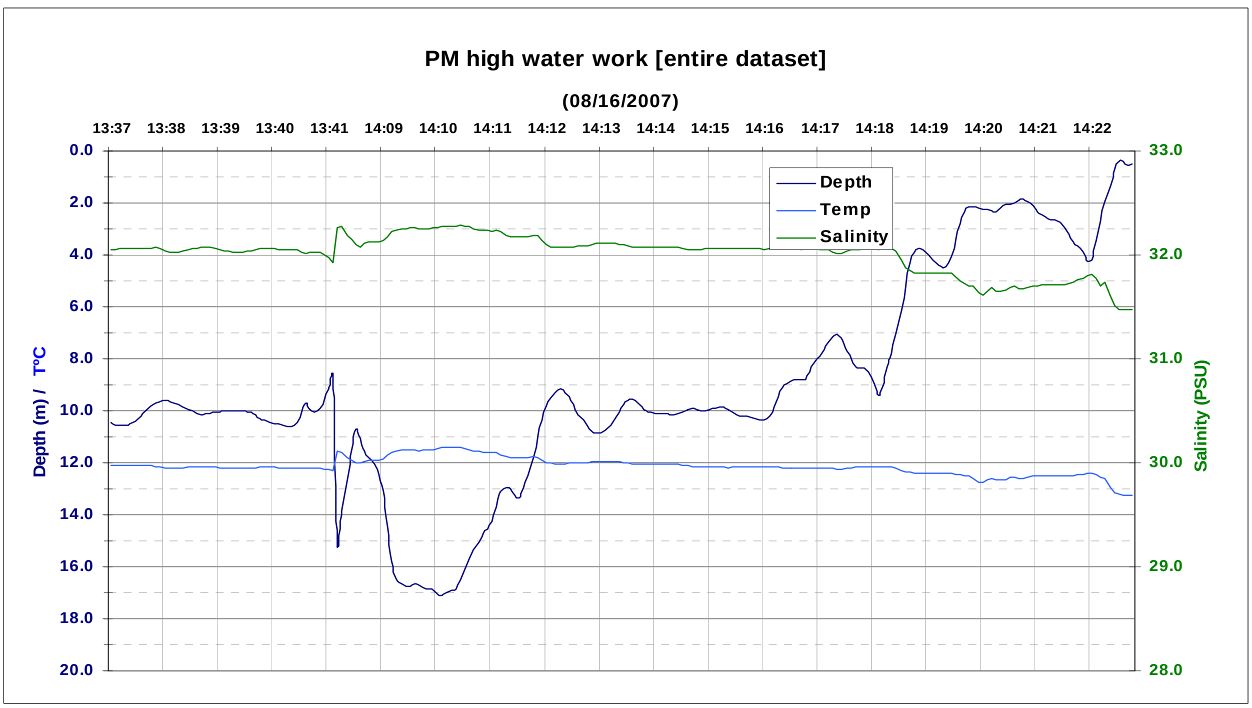


Figure 11. YSI 6600 output from the AM LW PM HW and Night LW August 16, 2007 samplings (Cont.)

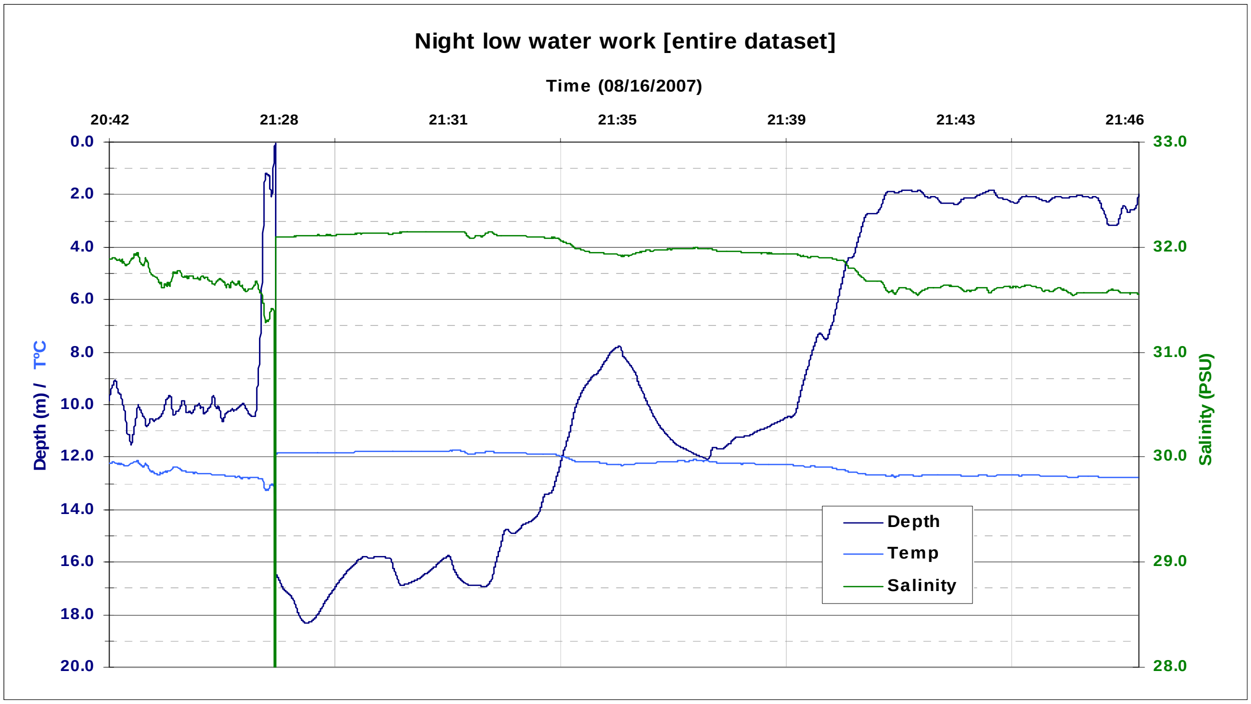
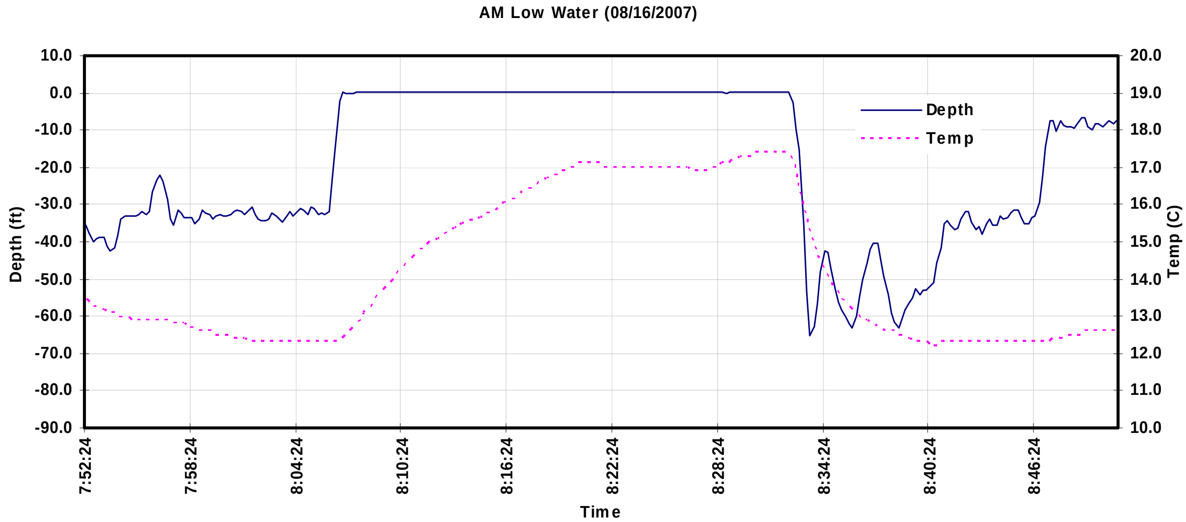
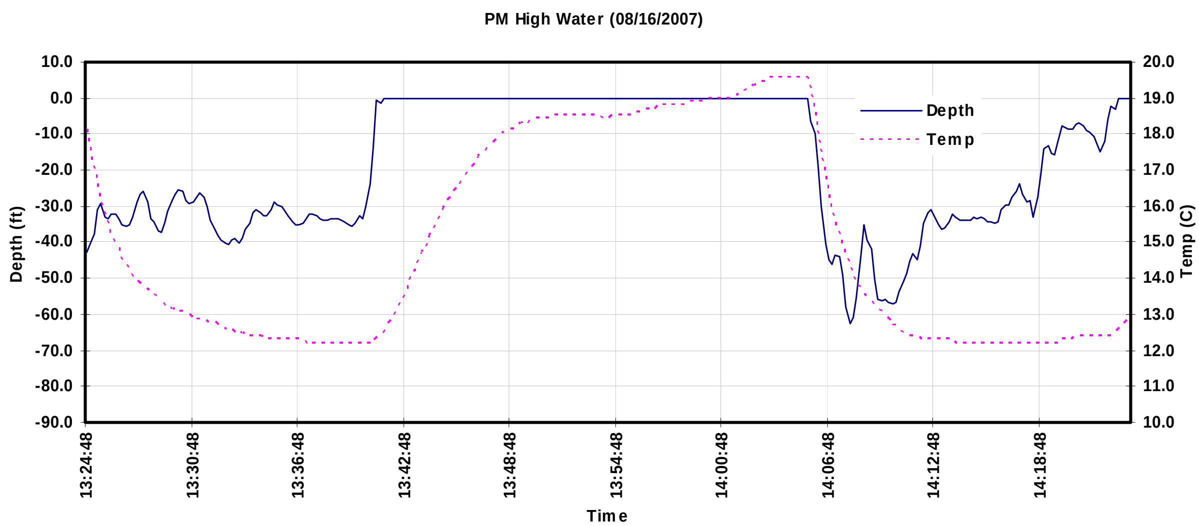


Figure 12. HOBO water level logger output from the August 16, 2007 sampling





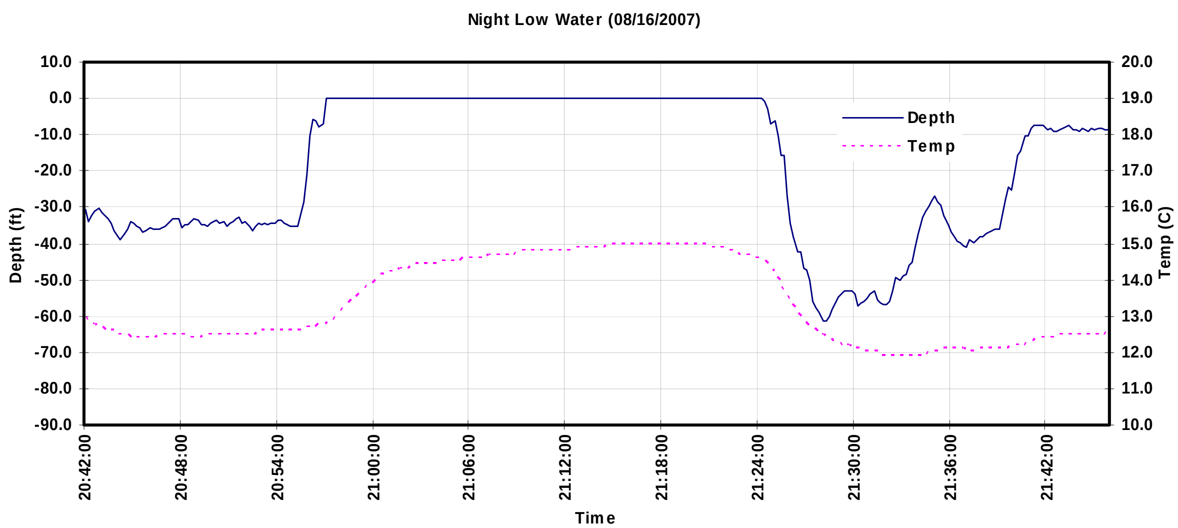


Table 9. Ichthyoplankton sampling data for August 16, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Mill Cove Ichthyoplankton sampling
16 August 2007
Oblique tows to current direction (61cm diameter net)

Tow Type	Mean Depth (YSI sonde depth @ ~1-2 ft above net, m/ft)	Mean Depth (sensor on net, (m/ft)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count diff	Temp (°C)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM Low water															
Target depth	32.2 / 9.8	33.1 / 10.1	0751	0806	15	1.4-1.7	333684	355085	**21401**	12.4	31.7	575.1	63.9	1.2	**168.0**
Composite															
bottom	51.8 / 15.8	53.1 / 16.2	0836	0841	5	1.5	355065	--------		12.0	32.0				
target	33.4 / 10.2	33.8 / 10.3	0841	0846	5	1.5	--------	--------		12.3	31.8				
surface	7.0 / 2.1	8.6 / 2.6	0846	0851	5	1.5	--------	383395	**28330**	12.8	31.4	761.3	84.6	1.6	**222.4**
PM High water															
Target depth	33.1 / 10.1	33.1 / 10.1	1326	1341	15	1.4-1.6	407613	437135	**29522**	12.2	32.0	793.3	88.1	1.7	**231.7**
Composite															
bottom	49.0 / 14.9	51.0 / 15.5	1406	1411	5	1.4-1.7	437135	--------		11.6	32.2				
target	35.7 / 10.9	32.2 / 9.8	1411	1416	5	1.5-1.6	--------	--------		12.0	32.1				
surface	14.6 / 4.4	11.1 / 3.4	1417	1423	6	1.5	--------	466655	**29520**	12.5	31.4	793.3	82.6	1.6	**231.7**
Night Low water															
Target depth	33.6 / 10.2	34.2 / 10.4	2041	2055	15	1.5	466655	495425	**28770**	12.5	31.7	773.1	85.9	1.7	**225.8**
Composite															
bottom	54.8 / 16.7	54.0 / 16.4	2127	2132	5	1.5	495425	--------		11.8	32.1				
target	34.3 / 10.4	34.2 / 10.4	2132	2139	7	1.5	--------	--------		12.5	32.0				
surface	7.3 / 2.2	8.9 / 2.7	2139	2146	7	1.5	--------	530401	**34976**	12.7	31.6	939.9	82.4	1.6	**274.5**
											Mean	**772.7**	**81.3**	**1.6**	**225.7**

Table 10. Analysis results of August 16, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
AM LW target	27	*Enchelyopus cimbrius*	3		**0.018**
		Ulvaria subbifurcata	8		**0.048**
		Glyptocephalus cynoglossus	1		**0.006**
		Scophthalmus aquosus	1		**0.006**
			13	**Larvae/m^3**	**0.077**
		CYT eggs	2		**0.012**
		Enchelyopus cimbrius eggs	3		**0.018**
		H4B eggs	13		**0.077**
		Scophthalmus aquosus eggs	14		**0.083**
		Tautogolabrus adspersus eggs	2		**0.012**
		Urophycis sp. eggs	1		**0.006**
			35	**Eggs/m^3**	**0.208**
AM LW composite	65	*Liparis atlanticus*	1		**0.004**
		Ulvaria subbifurcata	6		**0.027**
		Scophthalmus aquosus	2		**0.009**
		Pseudopleuronectes americanus	1		**0.004**
			10	**Larvae/m^3**	**0.045**
		CYT eggs	6		**0.027**
		Enchelyopus cimbrius eggs	10		**0.045**
		H4B eggs	22		**0.099**
		Scophthalmus aquosus eggs	19		**0.085**
		Tautogolabrus adspersus eggs	2		**0.009**
			59	**Eggs/m^3**	**0.265**
PM HW target	91	*Enchelyopus cimbrius*	3		**0.013**
		Liparis atlanticus	1		**0.004**
		Tautogolabrus adspersus	1		**0.004**
		Ulvaria subbifurcata	1		**0.004**
		Scophthalmus aquosus	3		**0.013**
				Larvae/m^3	**0.039**
		CYT (cunner/yellowtail) eggs	1		**0.004**
		H4B eggs	15		**0.065**
		Scophthalmus aquosus eggs	26		**0.112**
		Tautogolabrus adspersus eggs	3		**0.013**
			45	**Eggs/m^3**	**0.194**
PM LW composite	62	*Ulvaria subbifurcata*	6		**0.026**
		Tautogolabrus adspersus	1		**0.004**
		Liparis atlanticus	1		**0.004**
		Scophthalmus aquosus	2		**0.009**
			10	**Larvae/m^3**	**0.043**

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m³
		CYT eggs	3		**0.013**
		Enchelyopus cimbrius eggs	7		**0.030**
		H4B eggs	24		**0.104**
		Scophthalmus aquosus eggs	20		**0.086**
		Tautogolabrus adspersus eggs	3		**0.013**
			57	**Eggs/m³**	**0.246**
Night LW target	74	*Enchelyopus cimbrius*	1		**0.004**
		Ulvaria subbifurcata	7		**0.031**
		Scophthalmus aquosus	1		**0.004**
			9	**Larvae/m³**	**0.040**
		CYT eggs	4		**0.018**
		Enchelyopus cimbrius eggs	7		**0.031**
		H4B eggs	20		**0.089**
		Scophthalmus aquosus eggs	23		**0.102**
			54	**Eggs/m³**	**0.239**
Night LW composite	98	*Liparis atlanticus*	3		**0.011**
		Ulvaria subbifurcata	14		**0.051**
		Scophthalmus aquosus	2		**0.007**
		Pseudopleuronectes americanus	1		**0.004**
			20	**Larvae/m³**	**0.073**
		CYT eggs	10		**0.036**
		Enchelyopus cimbrius eggs	11		**0.040**
		H4B eggs	38		**0.138**
		Scophthalmus aquosus eggs	26		**0.095**
		Tautogolabrus adspersus eggs	3		**0.011**
		Urophycis sp. eggs	2		**0.007**
			90	**Eggs/m³**	**0.328**

	Eggs	Larvae	m³	Eggs #/m³	Larvae #/m³
AM LW target	35	13	168.0	0.208	0.077
AM LW comp	59	10	222.4	0.265	0.045
PM HW target	45	9	231.7	0.194	0.039
PM HW comp	57	10	231.7	0.246	0.043
Night LW target	54	9	225.8	0.239	0.040
Night LW comp.	90	20	274.5	0.328	0.073
		Mean		**0.247**	**0.053**

	Larvae loss/summer [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.052**	**250,793**	**2.51**	**25.1**	**251**
Daily mean	**0.053**	**254,730**	**2.55**	**25.5**	**255**

	Egg loss/summer [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.214**	**1,031,083**	**10.31**	**103.1**	**1031**
Daily mean	**0.247**	**1,189,726**	**11.90**	**119.0**	**1190**

H4B eggs - (gadid and merlucciid hakes, rocklings, butterfish, windowpane and Gulf Stream flounder)

Table 11. Zooplankton Analysis of August 16, 2007 samples by Dr. Ray Gerber, Brunswick, Maine

Species List	Numbers per Sample					
	AM Low Water Multi-depth	AM Low Water Target Depth	PM High Water Multi-depth	PM High Water Target Depth	Night Low Water Multi-depth	Night Low Water Target Depth
Calanoid Copepods:						
Acartia hudsonica	419,427	277,220	392,037	356,623	793,643	373,223
Acartia longiremis						
Acartia tonsa						
Calanus finmarchicus	138	208	277	277	203	343
Calanus hyperboreus						
Centropages hamatus	761	277	138	346	1,621	553
Centropages typicus						
Centropages spp.						
Eurytemora herdmani	27,943	25,108	21,234	34,238	40,736	37,073
Metrida longa						
Metridia lucens						
Microcalanus pusillus						
Paracalanus parvus			69			
Pseudocalanus spp.	12,104	12,519	13,211	12,381	13,883	12,796
Scolecithricella minor						
Temora longicornis	5,049	2,905	9,061	7,954	3,344	3,804
Tortanus discaudatus	157,147	137,503	185,643	370,180	280,085	208,607
Cyclopoid Copepods:						
Oithonia atlantica						
Oithonia similis						
Monstrilloid Copepods	277				101	69
Harpacticoid Copepods						
Cladocera:						
Evadne nordmanni	3,182	13,626	22,687	39,978	6,485	7,954
Pleopis polyphemoides	346	1,729	1,729	4,081	608	1,107
Podon leukarti	69	277		553	203	346
Euphausiids:						
Meganyctiphanes norvegica						
Thysanoessa inermis						
Cumaceans					507	484
Amphipods					811	415
Mysids:						
Erythrops erythrophthalma						208
Decapods (Carideans)						
Crustacea larvae:						
Cypris larvae						
Decapod larvae	9,062	60,175	5,326	9,061	10,843	76,775
Nauplii	138	899		208	304	69
Zoea (Brachyura)	3,251	1,522	899	1,038	1,723	2,836
Parasitic copepods						
Parasitic isopods						

Table 11. Zooplankton Analysis of August 16, 2007 samples by Dr. Ray Gerber, Brunswick, Maine (Cont.)

Gastropod mollusks:							
Lamellibranch larvae		138		138	101		
Veliger larvae	20,335	20,473	68,406	86,597	20,267	33,892	
Polychaetes:							
Autolytus prolifera			208			69	
Polychaete larvae				415	912	277	
Tomopterus sp.							
Echinoderms:							
Pluteus larvae							
Medusae	10,721	39,998	8,300	18,744	29,995	47,934	
Chaetognaths:							
Parasagitta elegans	484	484	69		1,520	553	
Larvacea:							
Fritillaria borealis			346	692		138	
Oikopleura dioica							
Ascidian larvae							
Sample total	**670,434**	**595,061**	**729,640**	**943,504**	**1,207,895**	**809,525**	
m^3 sampled	222	168	232	232	275	226	**Mean #/m^3**
#/m^3	**3015**	**3542**	**3149**	**4071**	**4400**	**3585**	**3627**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine
08/16/07

General Comments:

Subsamples used for analysis included 3 - 2 ml aliquots of the samples and all the organisms in each subsample were identified and counted. The samples were thoroughly mixed prior to and during the subsamplings. In most cases the counts for the identified species combined the immature and mature stages. Unlike in the previous samples adult stages were more abundant than the immature stages. This is to be expected in zooplankton samples from late summer. All six samples were free of detritus and contained very few algal cells such as diatoms.

The samples from 08/08/07 contained additional species not found in the previous winter and spring samplings. Also, the abundance of most copepods was much greater (two to four times) in these August samples than in the spring samples.

Specific Comments:

Acartia hudsonica
As in previous samples, the copepod *A. hudsonica*, was the most abundant organism in the samples. In the present samples they achieved maximum abundance in the night tows.

Tortanus discaudata
This predator copepod was the second most abundant copepod in the August samples. In the preserved samples it was often observed holding medusa in its feeding appendages suggesting that *Tortanus* preferentially feeds on such medusa.

Centropages hamata
In previous samples from the winter and spring this copepod was represented mostly by immature stages. In the August samples they were nearly all adults. This species is common in coastal waters but is rarely very abundant.

Eurytemora herdmanni
This copepod consisted mostly of adult stages and at least half of the females were carrying egg masses. *Eurytemora* were exceptionally abundant in the August samples. Abundances in night tows were slightly greater than day tows.

Pseudocalanus spp.
Two species of the copepod genus, *Pseudocalanus*, occur along the Maine coast. They consist of *P. neumani* and *P. moultoni*. They are similar morphologically and can not been accurately identified to species using a dissecting microscope.

In the August samples *Pseudocalanus* was fairly abundant and much more so than in the previous samples from the winter and spring. They consisted of a mix of immature and adults and they were not collected in greater abundance in the night tows. Some of the adult females were carrying eggs.

Cladocera
High numbers of cladocera occurred in the samples and a third species was found that did not occur in the winter or spring collections.

Amphipods, mysids and cumaceans
These three crustacea have a benthic or epibenthic life style but venture into the water column at night. That is when they were detected in the August samples. A single mysid species was found in the August samples and it was identified as *Erythrops erythrophthalma*.

Medusae
The August samples from Mill Cove contained mostly *Obelia* spp. and a few individuals of *Rathka octopuntata* were identified. They were however less abundant than in the spring samplings perhaps due to predation by *Tortanus* as described above. No day-night differences were seen in the data.

Chaetognaths
Parasagitta elegans was not significantly more abundant than in the previous spring samples. As in the spring samples this chaetognaths was most abundant in the night samplings.

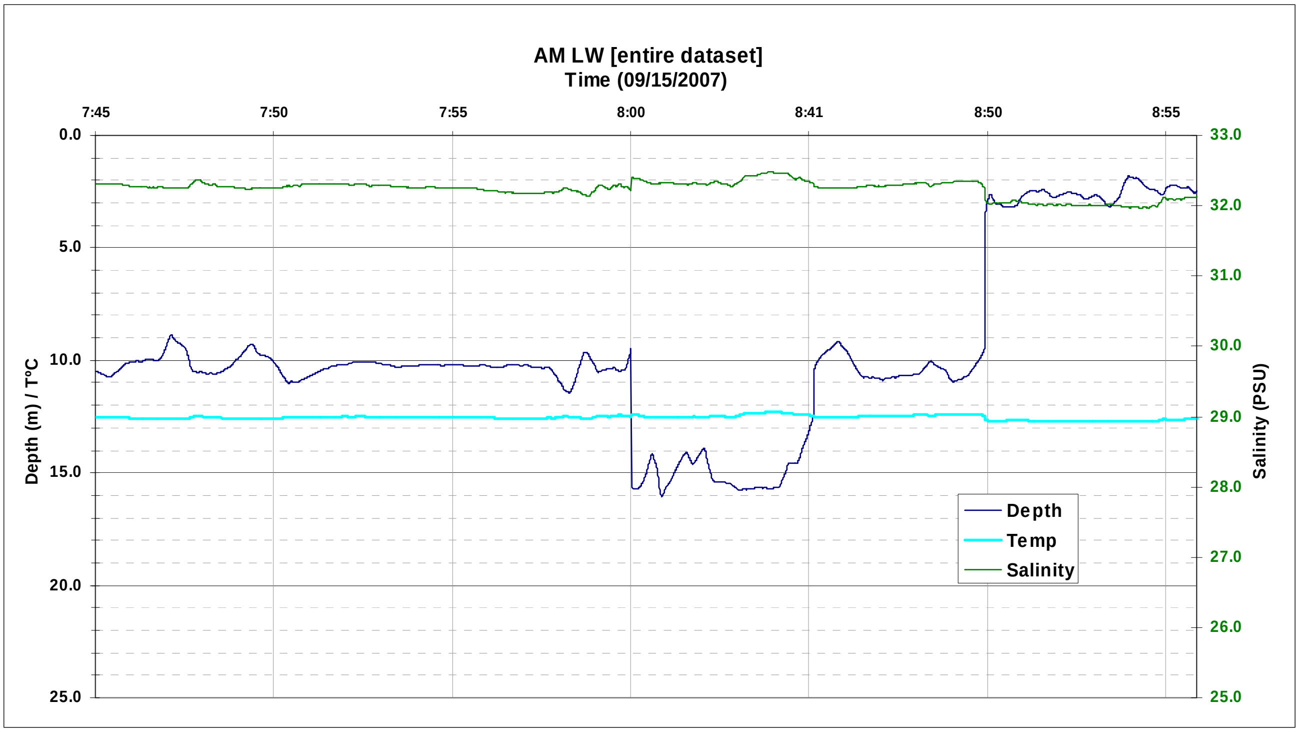
Veliger larvae
These larvae are the late developmental stages of benthic gastropod snails. They were exceptionally abundant in the August samplings.

Polychaete larvae
Polychaete larvae were for less abundant in the August samplings when compared to the spring samplings. This suggests that by August the polychaete larvae have left the water column seeking the benthos habitat.

Polychaetes
A few adult holoplanktonic polychaetes belonging to the species *Autolytus prolifera* were found in the August samples. As with all planktonic polychaetes they typically very scarce.

Crustacea larvae
This group contains a mix of holozooplankton and merozooplankton crustacean larvae. Decapod larvae and zoea were most abundant in these August samples while nauplii were scarce compared to the previous winter and spring samples. No lobster larvae were found in the subsamples.

Figure 13. YSI 6600 output from the AM LW PM HW and Night LW September 15, 2007 samplings



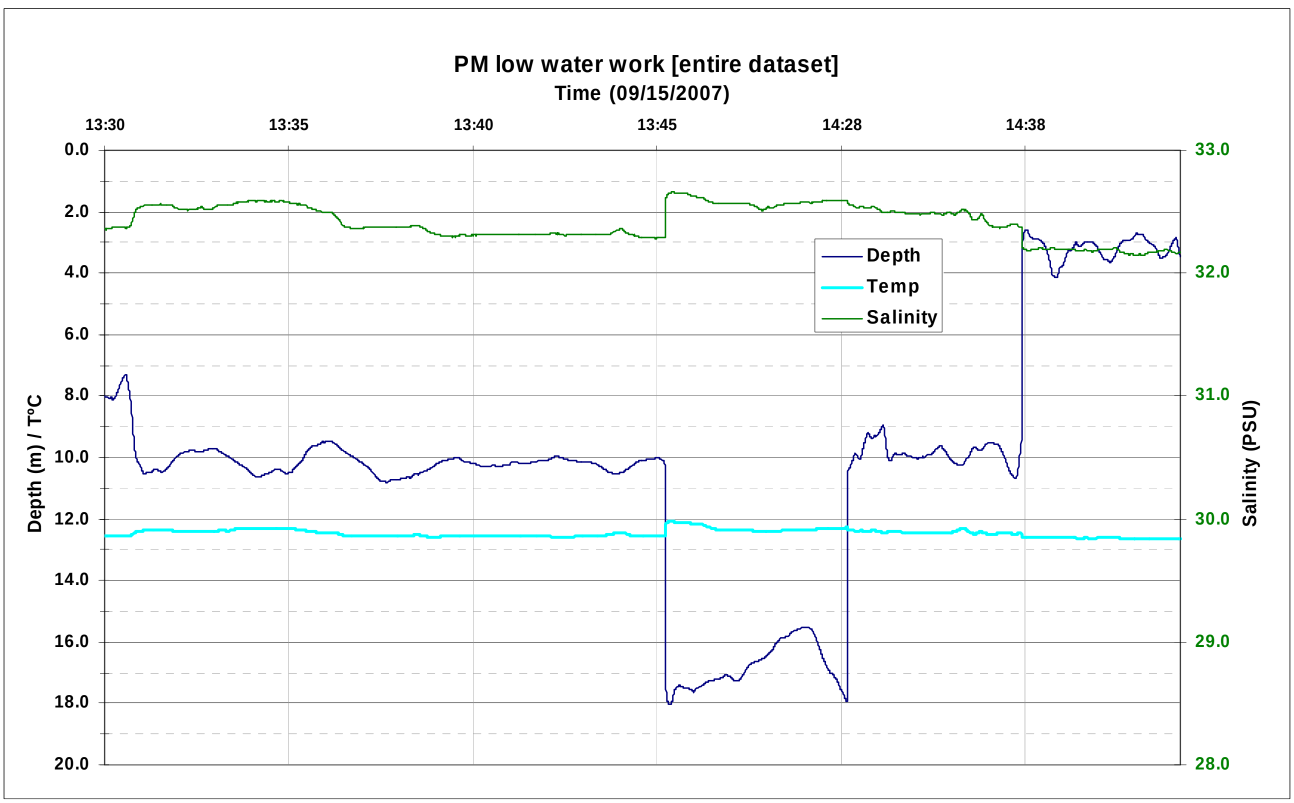


Figure 13. YSI 6600 output from the AM LW PM HW and Night LW September 15, 2007 samplings (Cont.)

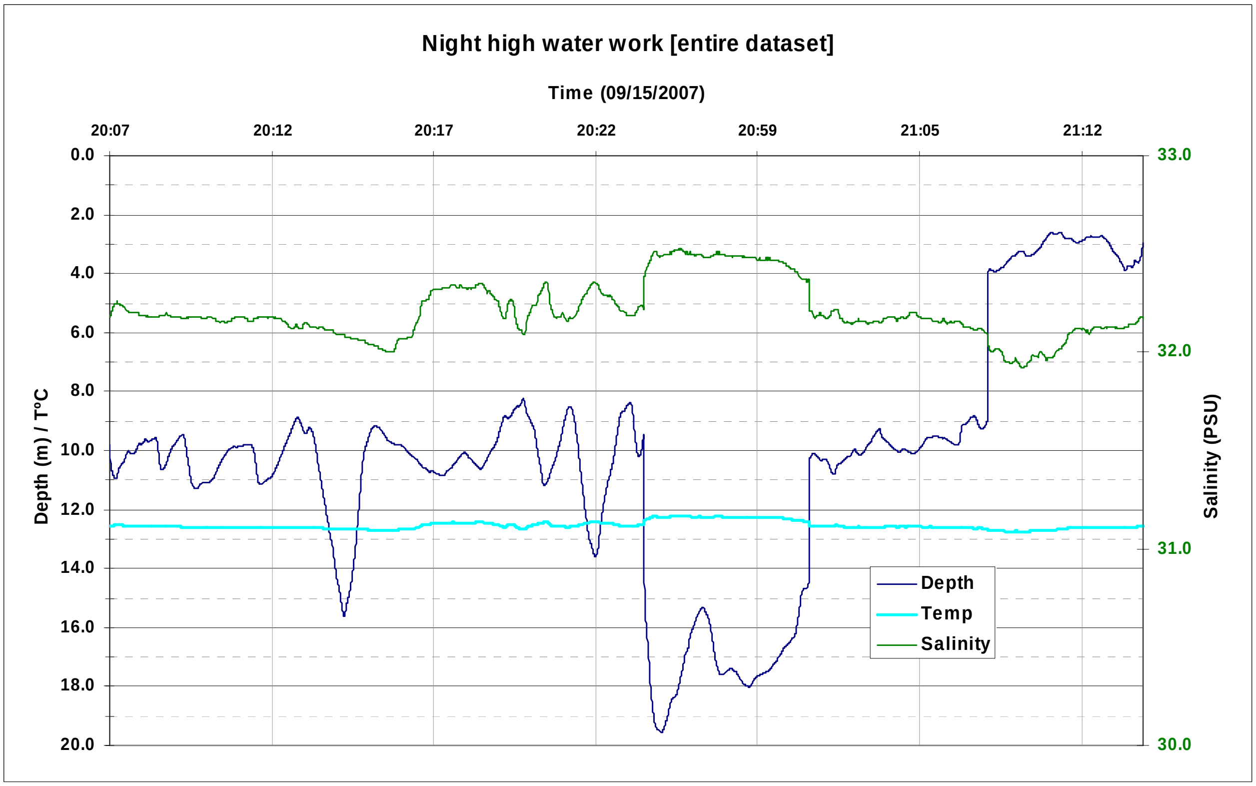
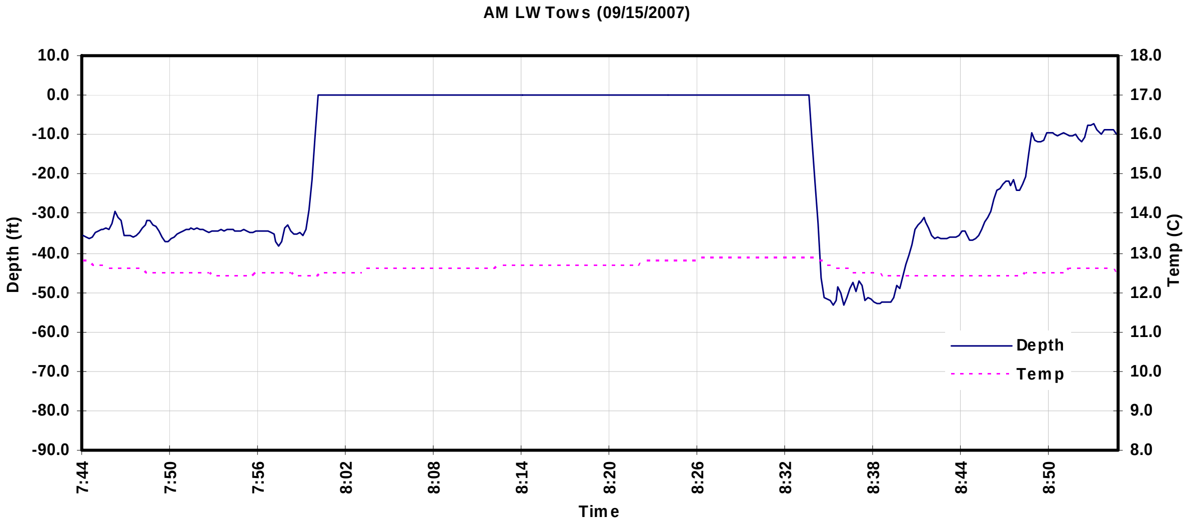
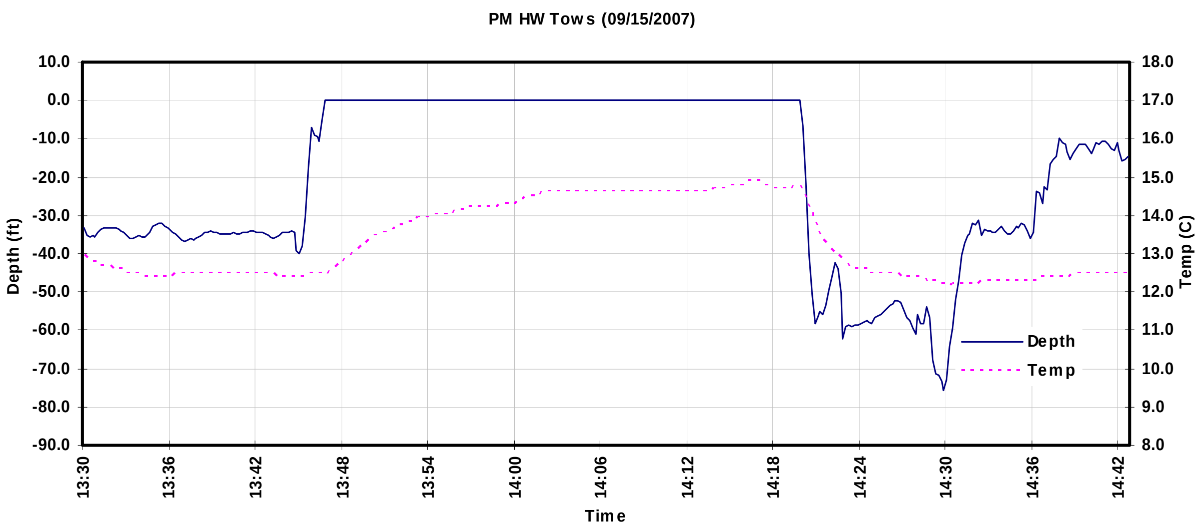


Figure 14. HOBO water level logger output from the September 15, 2007 sampling





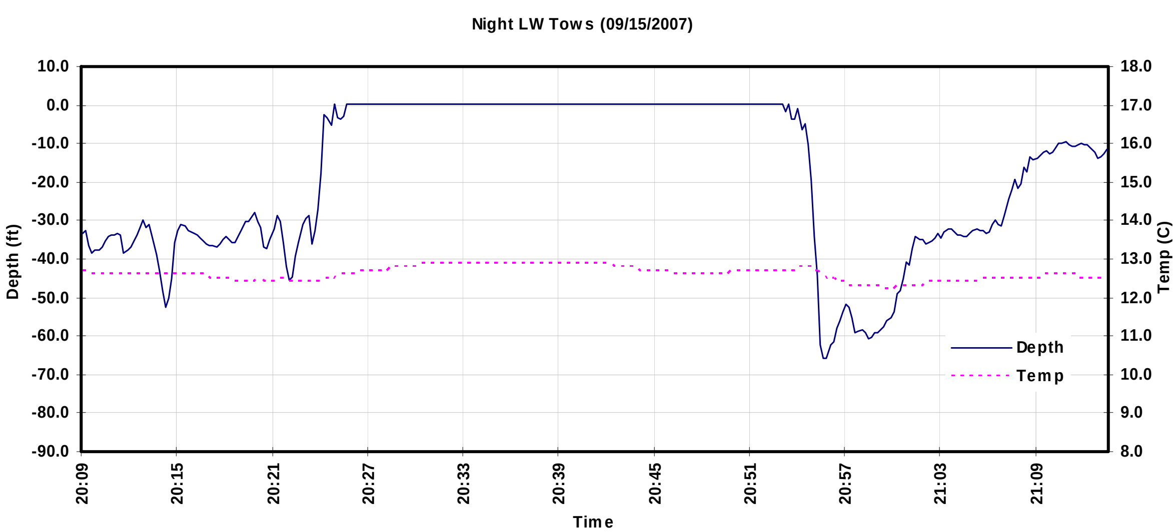


Table 12. Ichthyoplankton sampling data for September 15, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

DE LNG Ichthyoplankton/zooplankton sampling
15 September 2007
Oblique tows to current direction

Tow Type	Mean Depth (YSI sonde depth @ ~3 ft above net)	Mean Depth (sensor on net, ft/m)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count difference	Temp (°C)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM High water															
Target depth	33.7 / 10.2	34.5 / 10.5	0745	0800	15	1.5	557483	587258	**29775**	12.5	32.3	800.1	88.9	1.7	**233.7**
Composite															
bottom	49.4 / 15.0	51.2 / 15.6	0836	0841	5	1.4	587258	--------		12.5	32.4				
target	34.0 / 10.3	35.0 / 10.6	0842	0847	5	1.4	--------	--------		12.5	32.3				
surface	8.5 / 2.6	9.8 / 3.0	0850	0856	6	1.5	--------	622044	**34786**	12.7	32.0	934.8	97.4	1.9	**273.1**
PM Low water															
Target depth	33.1 / 10.1	34.8 / 10.6	1330	1345	15	1.5	622044	651494	**29450**	12.5	32.4	791.4	87.9	1.7	**231.2**
Composite															
bottom	55.2 / 16.8	56.4 / 17.2	1423	1428	5	1.6	651494	--------		12.3	32.6				
target	32.4 / 9.9	33.7 / 10.3	1432	1437	5	1.6	--------	--------		12.4	32.6				
surface	10.4 / 3.2	12.6 / 3.8	1438	1443	5	1.6	--------	683784	**32290**	12.6	32.2	867.7	96.4	1.9	**253.5**
Night High water															
Target depth	34.2 / 10.4	35.3 / 10.8	2009	2024	15	1.4-1.7	692633	723716	**31083**	12.6	32.2	835.3	92.8	1.8	**244.0**
Composite															
bottom	56.3 / 17.2	58.8 / 17.9	2055	2101	6	1.4	723716	--------		12.3	32.5				
target	32.2 / 9.8	34.1 / 10.4	2102	2107	5	1.4	--------	--------		12.6	32.2				
surface	11.4 / 3.5	11.3 / 3.4	2109	2114	5	1.4	--------	756921	**33205**	12.7	32.2	892.3	92.9	1.8	**260.6**
											Mean	**853.6**	**92.7**	**1.8**	**249.3**

Table 13. Analysis results of September 15, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton volume (ml)	Fish species		# in sample	Larvae/eggs	#/m^3
AM LW target	65	Enchelyopus cimbrius		3		**0.013**
		Scophthalmus aquosus		1		**0.004**
			Total	**4**	**Larvae/m^3**	**0.017**
		Scophthalmus aquosus eggs		1		**0.004**
		H4B eggs		13		**0.056**
		unidentifiable eggs		1		**0.004**
			Total	**15**	**Eggs/m^3**	**0.064**
AM LW composite	45	Enchelyopus cimbrius		2		**0.007**
			Total	**2**	**Larvae/m^3**	**0.007**
		H4B eggs		13		
		Scophthalmus aquosus eggs		1		**0.004**
		Enchelyopus cimbrius eggs		2		**0.007**
		CYT (cunner/yellowtail) eggs		1		**0.004**
		Tautogolabrus adspersus eggs		1		**0.004**
		unidentifiable eggs		1		**0.004**
			Total	**19**	**Eggs/m^3**	**0.070**
PM HW target	60	Enchelyopus cimbrius		1		**0.004**
		Tautogolabrus adspersus		1		**0.004**
		Glyptocephalus cynoglossus		1		**0.004**
			Total	**3**	**Larvae/m^3**	**0.013**
		H4B eggs		15		**0.065**
		Scophthalmus aquosus eggs		3		**0.013**
		Enchelyopus cimbrius eggs		1		**0.004**
			Total	**19**	**Eggs/m^3**	**0.082**
PM HW composite	55	Enchelyopus cimbrius		3		**0.012**
			Total	**3**	**Larvae/m^3**	**0.012**
		H4B eggs		10		**0.039**
		Enchelyopus cimbrius eggs		1		**0.004**
		Scophthalmus aquosus eggs		5		**0.020**
			Total	**16**	**Eggs/m^3**	**0.063**

Table 13. Analysis results of September 15, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine. (Cont.)

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
Night LW target	75	Enchelyopus cimbrius	5		**0.020**
		Clupea harengus	1		**0.004**
			6	**Larvae/m^3**	**0.025**
		H4B eggs	2		**0.008**
		Scophthalmus aquosus eggs	3		**0.012**
			5	**Eggs/m^3**	**0.020**
Night LW composite	65	Liparis atlanticus	1		**0.004**
			1	**Larvae/m^3**	**0.004**
		H4B eggs	17		**0.065**
		Scophthalmus aquosus eggs	3		**0.012**
		Urophycis sp. eggs	1		**0.004**
		Enchelyopus cimbrius eggs	1		**0.004**
			22	**Eggs/m^3**	**0.084**

H4B (gadid and merlucciid hakes, rocklings, butterfish, windowpane and Gulf Stream flounder)

	Eggs	Larvae	m^3	Eggs #/m^3	Larvae #/m^3
AM LW target	15	4	233.7	0.064	0.017
AM LW composite	19	2	273.1	0.070	0.007
PM HW target	19	3	231.2	0.082	0.013
PM HW composite	16	3	253.5	0.063	0.012
Night LW target	5	6	244.0	0.020	0.025
Night LW composite	22	1	260.6	0.084	0.004
			Mean	**0.064**	**0.013**

	Larvae loss/summer [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.018**	**87,863**	**0.88**	**8.8**	**88**
Daily mean	**0.013**	**62,406**	**0.62**	**6.2**	**62**

	Egg loss/ summer [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.056**	**268,105**	**2.68**	**26.8**	**268**
Daily mean	**0.064**	**308,477**	**3.08**	**30.8**	**308**

[1] **Assumes 22.8 vessel visits per summer**

Table 14. Zooplankton Analysis of September 15, 2007 samples by Dr. Ray Gerber, Brunswick, Maine

	Numbers per Sample					
Species List	**AM Low Water Multi-depth**	**AM Low Water Target Depth**	**PM High Water Multi-depth**	**PM High Water Target Depth**	**Night Low Water Multi-depth**	**Night Low Water Target Depth**
Calanoid Copepods:						
Acartia hudsonica	223,104	299,907	135,198	128,004	366,307	386,227
Acartia longiremis						
Acartia tonsa						
Calanus finmarchicus	208	138	69		138	69
Calanus hyperboreus						
Centropages hamatus	1,591	1,176	761	830	1,591	415
Centropages typicus						
Centropages spp.						
Eurytemora herdmani	41,154	32,508	32,508	34,722	44,405	45,512
Metrida longa						
Metridia lucens						
Microcalanus pusillus						
Paracalanus parvus						
Pseudocalanus spp.	4,358	3,735	3,251	1,383	5,672	3,943
Scolecithricella minor						
Temora longicornis	2,628	2,144	2,628	2,213	2,559	2,144
Tortanus discaudatus	69,720	129,203	137,964	149,400	115,370	120,350
Cyclopoid Copepods:						
Oithonia atlantica						
Oithonia similis						
Monstrilloid Copepods						
Harpacticoid Copepods	69	69		69	761	
Cladocera:						
Evadne nordmanni	2,559	1,868	4,565	2,075	1,383	2,905
Pleopis polyphemoides	1,383	1,453	4,842	1,314	2,421	1,453
Podon leukarti	69	69		69		
Euphausiids:						
Meganyctiphanes norvegica						
Thysanoessa inermis						
Cumaceans					623	1,245
Amphipods:						
Caprellids					830	
Gammarids			69	69	2,559	761
Mysids:						
Erythrops erythrophthalma						208
Mysis stenolepis					6	
Neomysis americana		69			69	69

Table 14. Zooplankton Analysis of September 15, 2007 samples by Dr. Ray Gerber, Brunswick, Maine (Cont.)

Decapods (Carideans):							
Crangon septemspinosa					347	138	
Eualus fabricii					4		
Lebeus groenlandicus					1		
Crustacea larvae:							
Cypris larvae							
Decapod larvae	3,873	2,767	2,421	1,937	3,597	3,595	
Megalopa (Brachyura)		138			69	69	
Nauplii				138	208	69	
Zoea (Brachyura)	1,038	692	415	208	761	1,591	
Parasitic copepods							
Parasitic isopods					69		
Gastropod mollusks:							
Lamellibranch larvae	69		138	346	968	138	
Veliger larvae	2,144	2,213	6,156	3,735	4,496	4,427	
Oligochaetes					623		
Polychaetes:							
Autolytus prolifera				138		208	
Polychaete larvae				208	138	69	
Tomopterus sp.							
Echinoderms:							
Pluteus larvae							
Medusae	5,188	830	4,911	3,113	2,628	9,960	
Chaetognaths:							
Parasagitta elegans					69		
Larvacea:							
Fritillaria borealis			69				
Oikopleura dioica							
Ascidian larvae							
Sample total	**359,155**	**478,979**	**335,965**	**329,971**	**558,672**	**585,565**	
m^3 sampled	**273**	**234**	**253**	**231**	**261**	**244**	**Mean #/m^3**
#/m^3	**1315**	**2049**	**1326**	**1427**	**2143**	**2400**	**1777**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine
09/15/07 (date as indicated on sample labels)

General Comments:

Subsamples used for analysis included 3 - 2 ml aliquots of the samples and all the organisms in each subsample were identified and counted. The samples were thoroughly mixed prior to and during the subsamplings. In most cases the counts for the identified species combined the immature and mature stages. Like in the previous samples from 08/16/07 adult stages were more abundant than the immature stages. This is to be expected in zooplankton samples collected from late summer and early fall.

Both the “PM High Water Multi-depth Composite” and the “PM High Water Target Depth” samples contained considerable amounts of dark brown, viscous, detritus whose exact nature and origin could not be determined. This material comprised about 25-30% by volume of the material in the two PM samples. In order to make accurate counts and identifications of the zooplankton this detritus was removed from each sub-sample. Also, the net from the “Night Low Water Multi-depth” sampling appeared to have inadvertently struck a buoy rope during the tow as it contained many non-planktonic epibenthic organisms. All samples contained small quantities of large centric diatoms.

The samples from 09/15/07 contained species not found in the previous samplings. However, these additional species were mostly the epibenthic types that were scraped off the buoy rope by the net. Also, the abundance of most zooplankton, with a few exceptions, was lower than from the September samples.

Specific Comments:

Acartia hudsonica
As in all previous samples, the copepod *A. hudsonica,* was the most abundant organism in the samples. Overall, they were lower in abundance than in the September samples and especially in the two High Water PM samples. The presence of the detritus in the bay may of affected the abundance of these copepods. As in the September samples *Acartia* achieved maximum abundance in the two night tows.

Tortanus discaudata
This predator copepod was the second most abundant copepod in the samples. As indicated previously the preserved *Tortanus* was often observed holding medusa in its feeding appendages apparently in the act of consuming the medusa. The abundance of *Tortanus* did not appear to be reduced by the detritus in the water.

Centropages hamata
In previous samples from the winter and spring this copepod was represented mostly by immature stages. In the August and now the September samples they were nearly all adults. This species is common in coastal waters but is rarely very abundant. The *Centropages* were slightly more abundant in the present (September) samples than in the previous samples. *Centropages* were reduced in abundance in the two detritus containing PM High Water samples perhaps due to the presence of the detritus.

Eurytemora herdmanni
This copepod consisted mostly of adult stages and now about only about 25% of the females were carrying egg masses. In the August samples about 50% of the adult females were carrying eggs. *Eurytemora* were generally more abundant in the September samples compared to the August samples. Abundances in night tows were slightly greater than day tows.

Pseudocalanus spp.
Two species of the copepod genus *Pseudocalanus* occur along the Maine coast. They consist of *P. neumani* and *P. moultoni*. Their differences are seen by examining each one under a compound microscope which prevents their routine analysis. In the present samples *Pseudocalanus* was much less abundant than in the previous samples from August. The present populations consisted mostly of adults and they were found in slightly greater abundance in the night tows. Almost none of the adult females were carrying eggs.

Cladocera
The overall abundance of the cladocera was much less than in the August samples and no night – day differences were seen.

Amphipods, decapods (caridians), mysids and cumaceans
These crustacea have an epibenthic life style but migrate up into the water column at night. Presumably, this explains there occurrence in the present samples and those from the May and August. However, additional species of these organisms were found in the present samples, especially from the net that struck the buoy rope (Night Low Water Multi-depth).

Medusae
The present September samples from Mill Cove contained much fewer medusae than from August. As before the medusae consisted mostly *Obelia*.

Chaetognaths
Parasagitta elegans was very scarce in the present samples and only occurred in one of the night samples.

Veliger larvae
These larvae are the late developmental stages of benthic gastropod snails. They were now greatly reduced in abundant when compared to the August samplings. This suggests that most veligers have metamorphosed into the sub-adult stage and settled to the bottom.

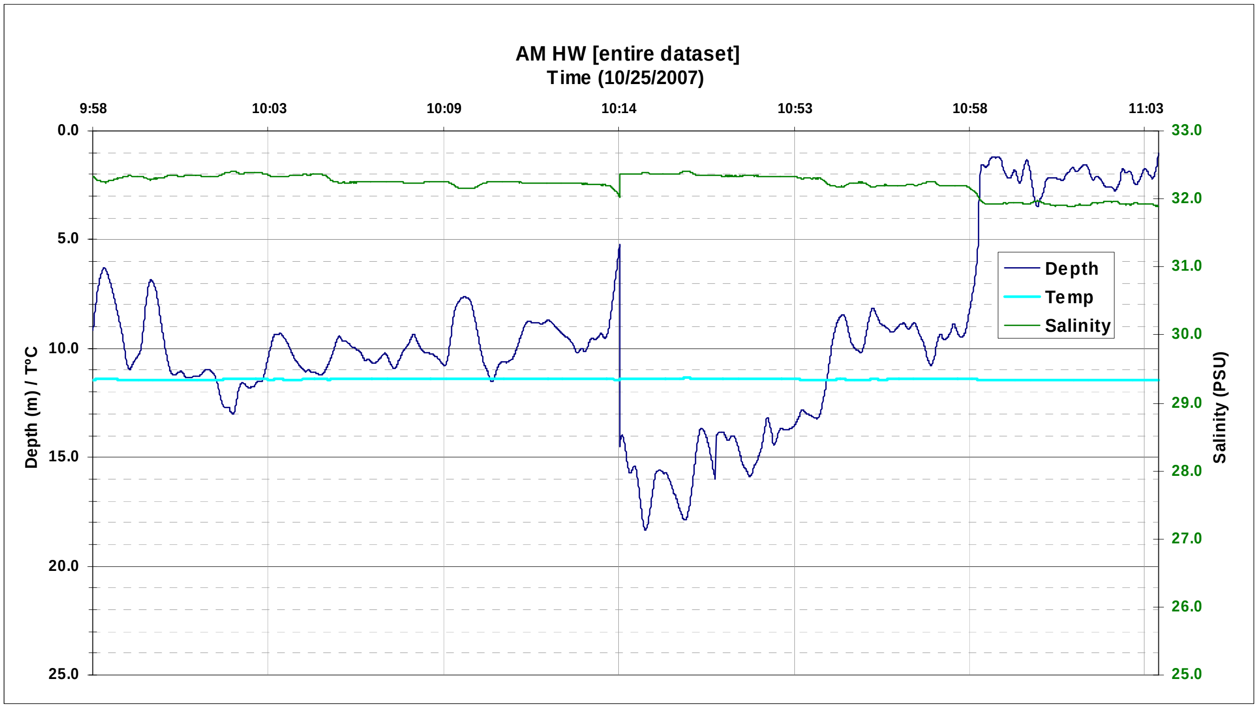
Polychaete larvae
Polychaete larvae were even less abundant than in the August samples. This suggests that by August and September the polychaete larvae have left the water column seeking the benthos habitat.

Polychaetes
A few adult holoplanktonic polychaetes belonging to the species *Autolytus prolifera* were found in the September samples. This is similar to what was observed for the August samples. As with all planktonic polychaetes they typically very scarce.

Crustacea larvae
This group contains a mix of holozooplankton and merozooplankton crustacean larvae. Decapod larvae, zoea and naupliar stages were much less abundant in these September samples compared to those from August. A few megalopa (brachyura) stages were recorded in the present samples. No lobster larvae were found in the Sepember samples.

Acarina (mites), pycnogonids (sea spiders), ectoprocta larvae (bryozoa), Asterias (sea stars) and oligochaetes
These epibenthic organisms were found in the "Night Low Water Multi-depth" sample that struck the buoy rope. Clearly, they were scraped off the rope by the net.

Figure 15. YSI 6600 output from the AM HW PM LW October 25, 2007 samplings



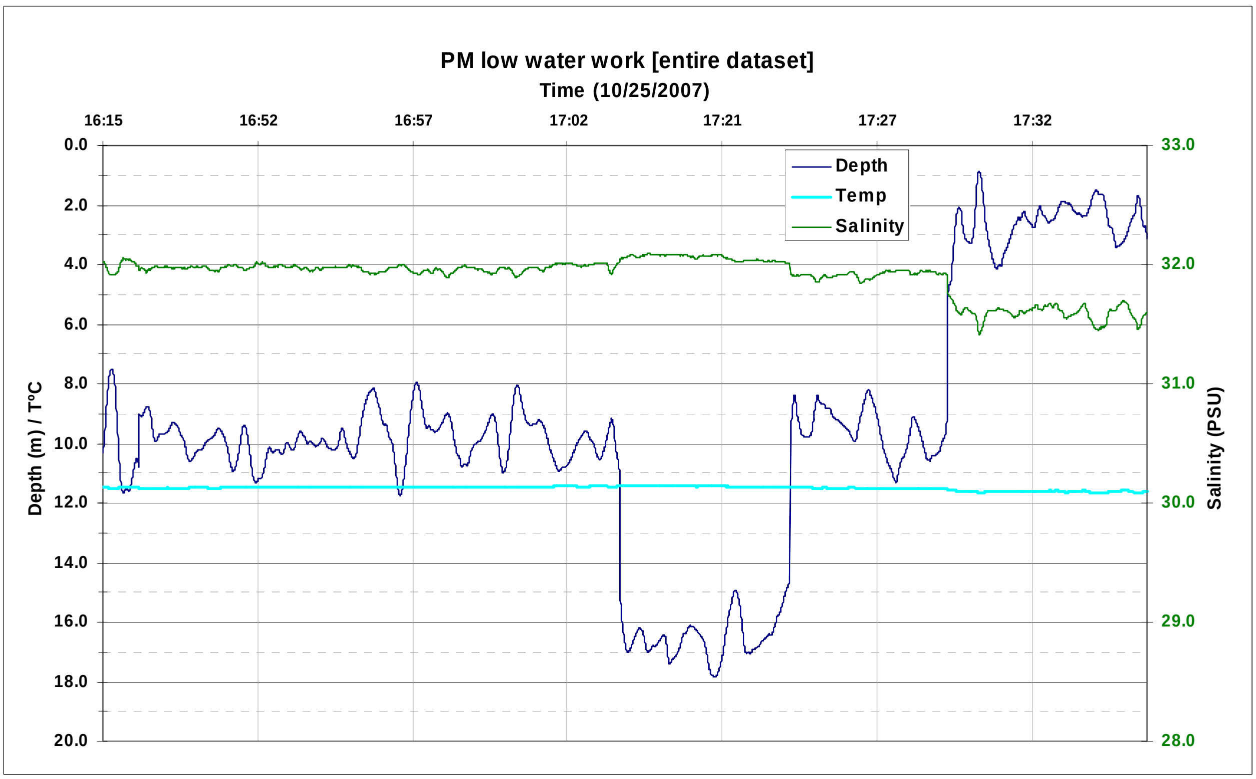
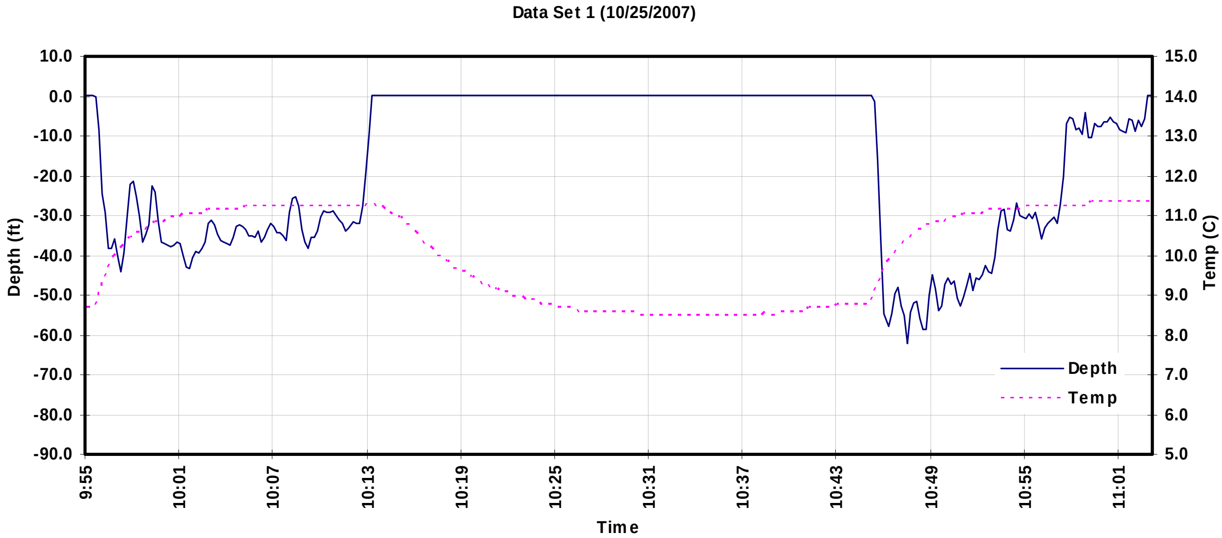


Figure 16. HOBO water level logger output from the October 25, 2007 sampling



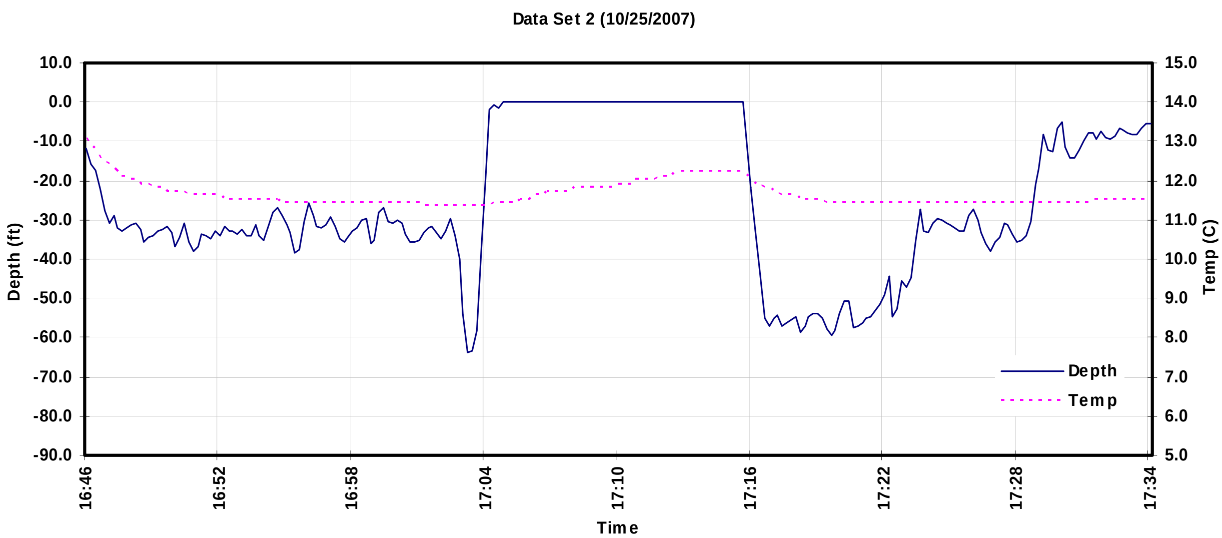


Table 15. Ichthyoplankton sampling data for October 25, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

DE LNG Ichthyoplankton/zooplankton sampling
25 October 2007
Oblique tows to current direction

Tow Type	Mean Depth (YSI sonde depth @ ~3 ft above net)	Mean Depth (sensor on net, ft/m)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count difference	Temp (ºC)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM High water															
Target depth	32.7 / 10.0	33.9 / 10.3	0958	1013	15	1.4-1.7	719604	752418	**32814**	11.4	32.3	881.8	98.0	1.9	**257.6**
Composite															
bottom	49.9 / 15.2	51.1 / 15.5	1047	1052		1.4-1.6	752418			11.4	32.3				
target	32.0 / 9.8	32.4 / 9.9	1053	1058		1.4-1.6				11.4	32.2				
surface	6.8 / 2.1	7.3 / 2.2	1058	1103	15	1.5-1.6		779864	**27446**	11.4	31.5	737.6	82.0	1.6	**215.4**
PM Low water															
Target depth	32.3 / 9.8	32.6 / 9.9	1648	1703	15	1.5-1.7	787445	822637	**35192**	11.5	32	945.7	105.1	2.0	**276.2**
Composite															
bottom	54.2 / 16.5	55.4 / 16.8	1718	1723	5	1.1-1.4	822637			11.4	32.1				
target	31.5 / 9.6	35.7 / 10.9	1724	1729	5					11.5	31.9				
surface	8.5 / 2.6	9.7 / 2.9	1731	1736	5			850873	**28236**	11.6	31.6	758.8	84.3	1.6	**221.6**
Night High water															
Target depth	Not taken								**0**			0.0	#DIV/0!	#DIV/0!	**0.0**
Composite															
bottom															
target															
surface									**0**			0.0	#DIV/0!	#DIV/0!	**0.0**
											Mean	**831.0**	**92.3**	**1.8**	**242.7**

Table 16. Analysis results of October 25, 2007 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
AM HW target	20	Enchelyopus cimbrius	2		
		Total	**2**	**Larvae/m^3**	**0.008**
AM HW composite	14	Clupea harengus	1		
		Total	**1**	**Larvae/m^3**	**0.004**
		H4B eggs	2		
		Total	**2**	**Eggs/m^3**	**0.009**
PM LW target	28	Clupea harengus	1		
		Enchelyopus cimbrius	2		
		Total	**3**	**Larvae/m^3**	**0.011**
PM LW composite	26	Clupea harengus	6		
		Enchelyopus cimbrius	1		
		Total	**7**	**Larvae/m^3**	**0.032**
night HW target		**Not taken**			
night HW composite		**Not taken**			

	Eggs	Larvae	m^3 sampled	Eggs #/m^3	Larvae #/m^3
AM LW target	0	2	257.6	0.000	0.008
AM LW comp	2	1	215.4	0.009	0.005
PM HW target	0	3	276.2	0.000	0.011
PM HW comp	0	7	221.6	0.000	0.032
Night LW target	**Not taken**	-----	-----	-----	-----
Night LW comp.	**Not taken**	-----	-----	-----	-----
		Mean	**242.7**	**0.002**	**0.014**

	Larvae loss/winter [1]		Equivalent adult loss		
			1/100,000	1/10,000	1/1,000
Target loss	**0.009**	**89,582**	**0.90**	**9.0**	**90**
Daily mean	**0.014**	**131,907**	**1.32**	**13.2**	**132**

	Egg loss/summer [1]		Equivalent adult loss		
			1/100,000	1/10,000	1/1,000
Target loss	**0.000**	**0**	**0.00**	**0.0**	**0**
Daily mean	**0.002**	**22,326**	**0.22**	**2.2**	**22**

H4B eggs - (gadid and merlucciid hakes, rocklings, butterfish, windowpane and Gulf Stream flounder)

[1] **Assumes seawater usage of 211,421m^3/visit and 45.5 vessel visits per winter**

Table 17. Zooplankton Analysis of October 25, 2007 samples by Dr. Ray Gerber, Brunswick, Maine

Species List	AM Low Water Target Depth	AM High Water Multi-depth	PM High Water Target Depth	PM Low Water Multi-depth	Night High Water Multi-depth	Night High Water Target Depth
Calanoid Copepods					no sample	no sample
Acartia hudsonica	153,800	59,340	113,200	103,133		
Acartia longiremis						
Acartia tonsa						
Calanus finmarchicus	50	153	200			
Calanus hyperboreus						
Centropages hamatus	1,550	1,763	1,500	1,108		
Centropages typicus	300	192	767			
Centropages spp.						
Eurytemora herdmani	29,900	10,273	19,700	15,808		
Metrida longa						
Metridia lucens						
Microcalanus pusillus						
Paracalanus parvus						
Pseudocalanus spp.	2,900	1,457	1,467	2,800		
Scolecithricella minor						
Temora longicornis	5,350	10,158	16,400	3,500		
Tortanus discaudatus	34,600	18,247	30,400	43,633		
Cyclopoid Copepods						
Oithonia atlantica	50					
Oithonia similis	50					
Monstrilloid Copepods	100					
Harpacticoid Copepods						
Cladocera						
Evadne nordmanni						
Pleopis polyphemoides	50	38		58		
Podon leukarti	50	38	33	58		
Euphausiids						
Meganyctiphanes norvegica						
Thysanoessa inermis						
Cumaceans						
Amphipods						
Caprellids						
Gammarids			167			
Mysids						
Erythrops erythrophthalma						
Mysis stenolepis						
Neomysis americana			33			
Decapods (Carideans)						

Table 17. Zooplankton Analysis of October 25, 2007 samples by Dr. Ray Gerber, Brunswick, Maine (Cont.)

Species List	AM Low Water Target Depth	AM High Water Multi-depth	PM High Water Target Depth	PM Low Water Multi-depth	Night High Water Multi-depth	Night High Water Target Depth	
Crustacea larvae					no sample	no sample	
Cypris larvae							
Decapod larvae	200	345	400	175			
Megalopa (Brachyura)							
Nauplii		38					
Zoea (Brachyura)	2,350	115	567	2,100			
Parasitic copepods							
Parasitic isopods							
Gastropod mollusks							
Lamellibranch larvae							
Veliger larvae	1,400	1,802	3,667	350			
Polychaetes							
Autolytus prolifera	50						
Polychaete larvae			67				
Tomopterus sp.							
Echinoderms							
Pluteus larvae							
Medusae	6,250	3,067	4,200	1,458			
Chaetognaths							
Parasagitta elegans	100	77	67	117			
Larvacea							
Fritillaria borealis	50		200	117			
Oikopleura dioica							
Ascidian larvae			33				
Ectoprocta larvae	50						
Sample total	**85,400**	**47,763**	**79,868**	**71,282**	**0**	**0**	
m^3 sampled	**258**	**215**	**276**	**222**	**0**	**0**	**Mean #/m^3**
#/m^3	**332**	**222**	**289**	**322**	**------**	**------**	**291**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine
From 10/25/07

Prepared by Ray P. Gerber
November 13, 2007

General Comments

Subsamples used for analysis included 3 - 2 ml aliquots of the samples and all the organisms in each subsample were identified and counted. The four samples were thoroughly mixed prior to and during the subsamplings. The counts for the identified species include both the immature and mature stages. All samples were free of debris and this made analysis more accurate and faster.

The abundance of most species in the present samples was about one-half to one-fourth of what was found in the previous samples from September. Some species previously found were entirely missing while three species of copepods were found for the first time. As in the previous samples adult stages were more abundant than the immature stages and copepods dominated the samples. Nearly all of the adult female copepods were devoid of attached egg masses. This is typical for late fall zooplankton since phytoplankton levels are approaching minimum levels for the year.

Specific Comments

Acartia hudsonica
Despite its lower abundance (compared to the September samples) the copepod *A. hudsonica,* was still the most abundant organism in the samples. *A. hudsonica* was most abundant in the AM Low Water Target Depth sample. Similarly, this copepod was also most abundant in the AM Low Water Target Depth sample from September. For both September and October *A. hudsonica* was least abundant in the samples from high water.

Tortanus discaudata
This predatory copepod was the second most abundant copepod in the samples with maximum abundance in the PM Low Water Multi-depth sample. PM samples from September also contained the highest amounts of this copepod. As indicated previously, preserved *Tortanus* was often observed holding medusa in its feeding appendages apparently in the act of consuming the medusa.

Eurytemora herdmanni
This copepod comprised the third most abundant organism in the samples and this is true for previous samples. *Eurytemora* was reduced in abundance and consisted almost entirely of adult stages with only a few of the females carrying egg masses.

Centropages hamatus and Centropages typicus
In the current samples *Centropages hamatus* consisted almost entirely of adult stages. This species is common in coastal waters but is rarely very abundant. *Centropages hamataus* was about as abundant as in the September day-time samples. For the first time, *Centropages typicus,* was recorded in the present samples. This copepod is common in the Gulf of Maine and in coastal bays with little freshwater input. It reaches peak abundance from fall to winter in the Gulf of Maine. In estuaries and coastal bays such as, Passamaquoddy Bay, its con-generic associate, *Centropages hamatus,* is more abundant throughout the year. The present data confirms this.

Pseudocalanus spp.
This copepod was generally less abundant in the present samples when compared to the September day-time samples. Two species of the copepod genus *Pseudocalanus* occur along the Maine coast. They consist of *P. neumani* and *P. moultoni* and as described earlier they are difficult to identify to species unless each one is examimed under a compound microscope. The present populations consisted mostly of adults and almost none of the adult females were carrying eggs.

Oithona similis and *O. atlantica*
One individual of each of these cyclopoid copepod species occurred in the samples and for the first time. The appearance of the smaller of the two, *Othona similis*, is no doubt accidental since the mesh of the net used to collect the samples is too large for this species. However, this species is often very abundant in the Gulf of Maine region throughout the year. The other cyclopoid copepod, *Oithona atlantica,* is a boreal species and is longer in length than *O. similes.* Its slenderness however permits it to slip through the meshes of the sampling net used and explains it rarity to the samples.

Cladocera:
The overall abundance of the cladocera was further reduced when compared to the September samples. *Evadne nordmanni* was now absent from the samples and *Pleopis polyphemoides* was reduced to very low numbers.

Amphipods, Decapods (caridians), Mysids and Cumaceans
In previous samples this group of crustacea were most abundant in the night samples and were occasionally (sporatically) present in day-time samples. In the present October samplings a few gammarid amphipods appeared in the AM High Water Target Depth sample. No caprellid amphipods were found. A single mysid was found and only in one sample and no cumaceans were detected in any of the samples. All four of these organisms were further reduced in abundance in the present samples.

Medusae:
The medusae were still abundant in the samples and only slightly less so when compared to the September samples. As before, the medusae consisted mostly *Obelia sp.* and many were found in the clutches of the copepod *Tortanus discaudatus*.

Chaetognaths:
Parasagitta elegans occurred in all four of the present samples though in low abundance. In the previous samples from September they occurred only in one of the night samples. Generally, this chaetognath reaches peak abundances in late summer and early fall in the Gulf of Maine area.

Veliger larvae:
These larvae of gastropod snails were found in all four of the samples. Maximum abundance occurred in the two high water samples which is also what was found for the September day-time samples. Minimum abundance was found in the Low Water Multi-depth sample and the same occurred in the previous September samples. These larvae were further reduced in abundant when compared to the previous samplings. This suggests that most veligers have metamorphosed into the sub-adult stage and settled to the bottom.

Polychaete larvae:
Polychaete larvae were even less abundant than in the August samples. This suggests that by August and September the polychaete larvae have left the water column seeking the benthos habitat.

Polychaetes:
A single adult holoplanktonic polychaete, *Autolytus prolifera*, and a single polychaete larvae was found in the October samples. This indicates a further seasonal reduction of both organisms.

Crustacea larvae:
This group contains a mix of holo- and merozooplankton crustacean larvae. Both decapod larvae and zoea occurred in all four samples. Decapod larvae were now reduced to just a few hundred per sample in contrast to a few thousand per sample in the September samples. Zoea appeared rather abundant in the two low water samples and very low in the two high water samples. A similar pattern was observed in the September samples. No crab megalopa larvae and no lobster larvae were found in the October samples.

Fish larvae and Fish eggs:
No fish larvae or fish eggs were detected in the subsamples.

Summary to-date

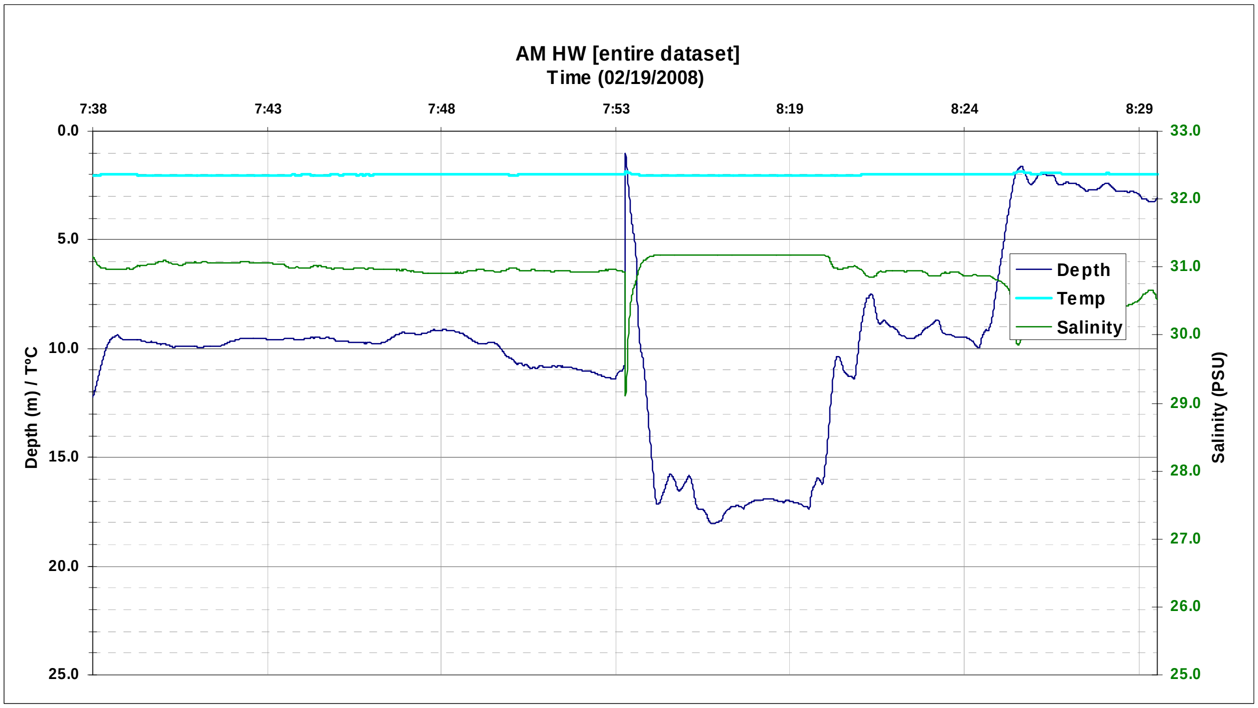
Table 18 shows the average target depth (32-35 ft.) density of fish larvae, fish eggs, and zooplankton for each of the sampling periods as well as the average for the winter and summer seasons and the year.

Table 18. Average target depth density of fish larvae, fish eggs, and zooplankton

Target depth density values (#/m^3)

Month	Fish larvae		Fish eggs		Zooplankton	
October 06	0.047		0.000			
February 07	0.054		0.004		63	
October 07	0.009		0.000		310	
Winter average	**0.037**		**0.001**		**187**	
May 07	0.134		0.065		2620	
August 07	0.052		0.214		3733	
September 07	0.013		0.064		1959	
Summer average	**0.066**		**0.114**		**2771**	
Annual average		**0.062**		**0.069**		**1737**

Figure 17. YSI 6600 output from the AM HW PM LW February 19, 2008 samplings



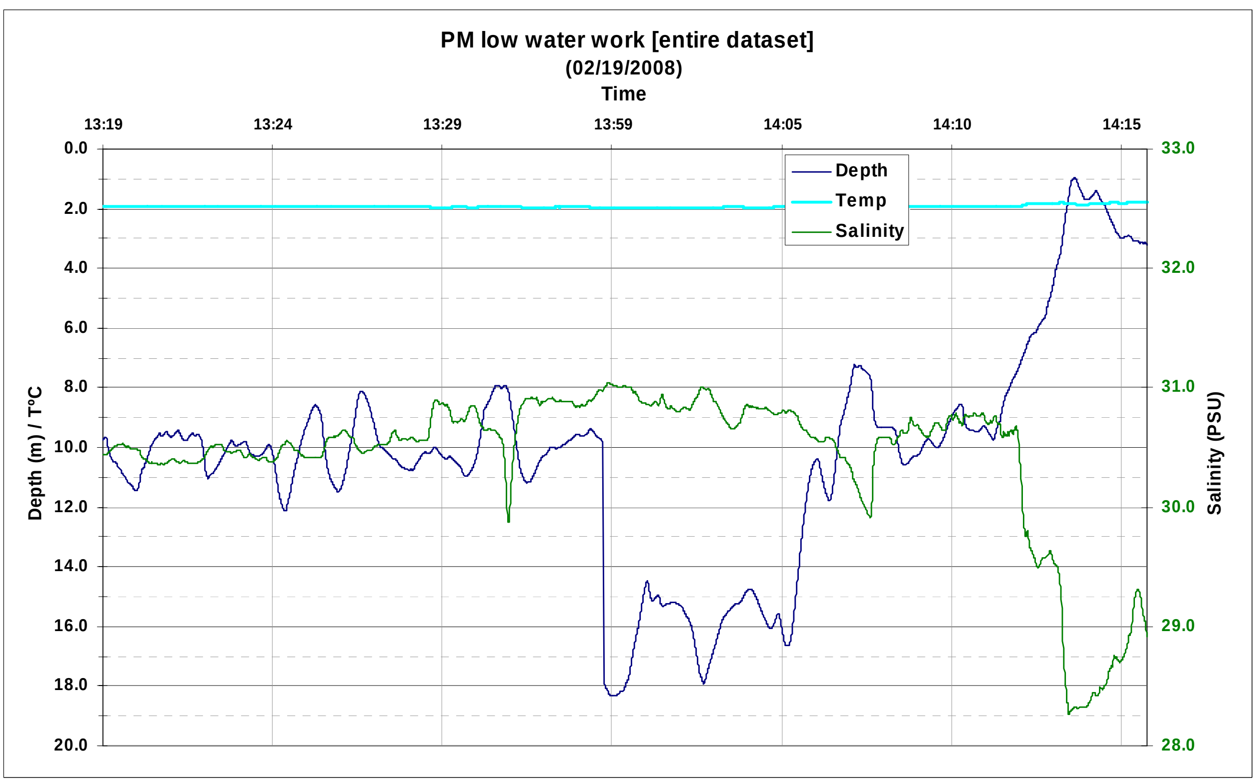


Figure 17. YSI 6600 output from the AM HW PM LW February 19, 2008 samplings (Cont.)

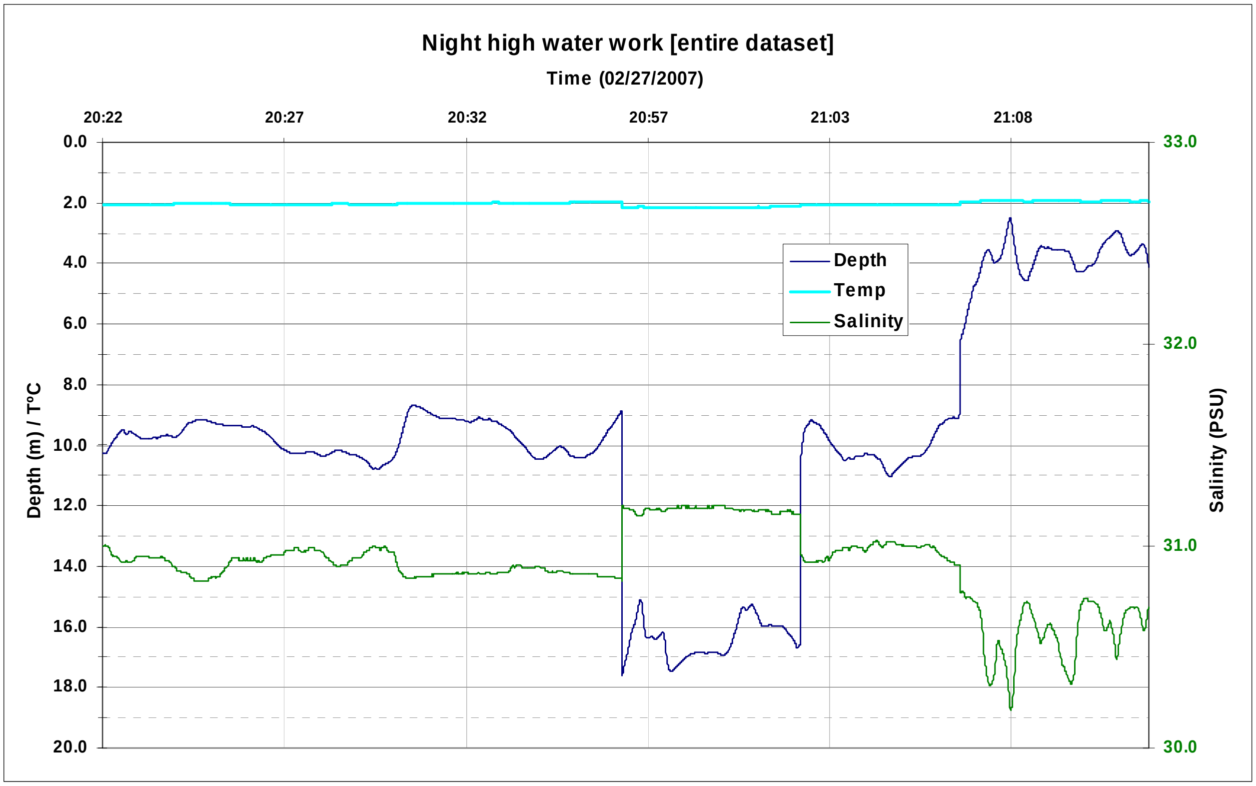
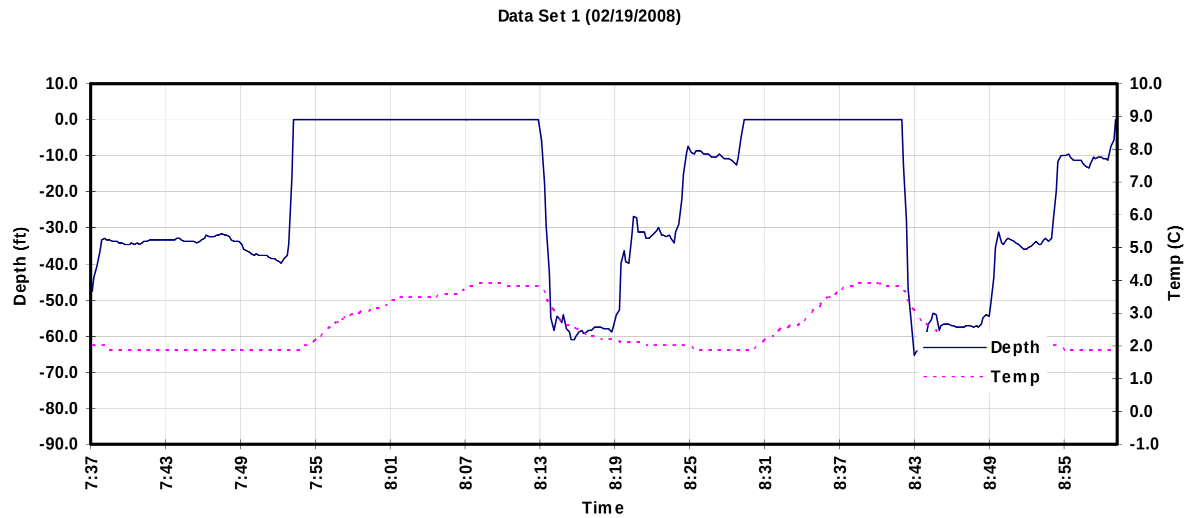
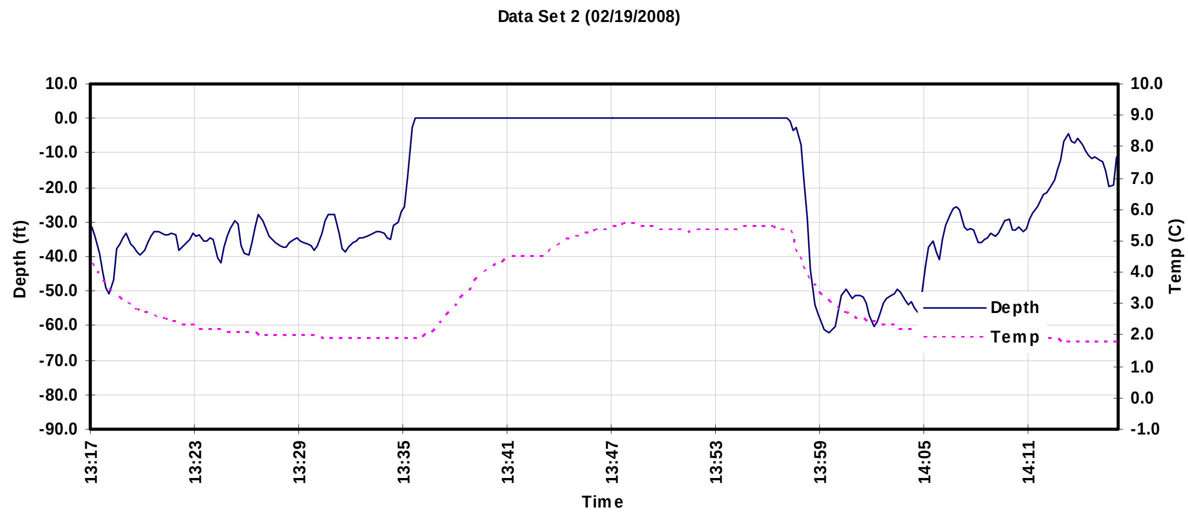


Figure 18. HOBO water level logger output from the February 19, 2008 sampling





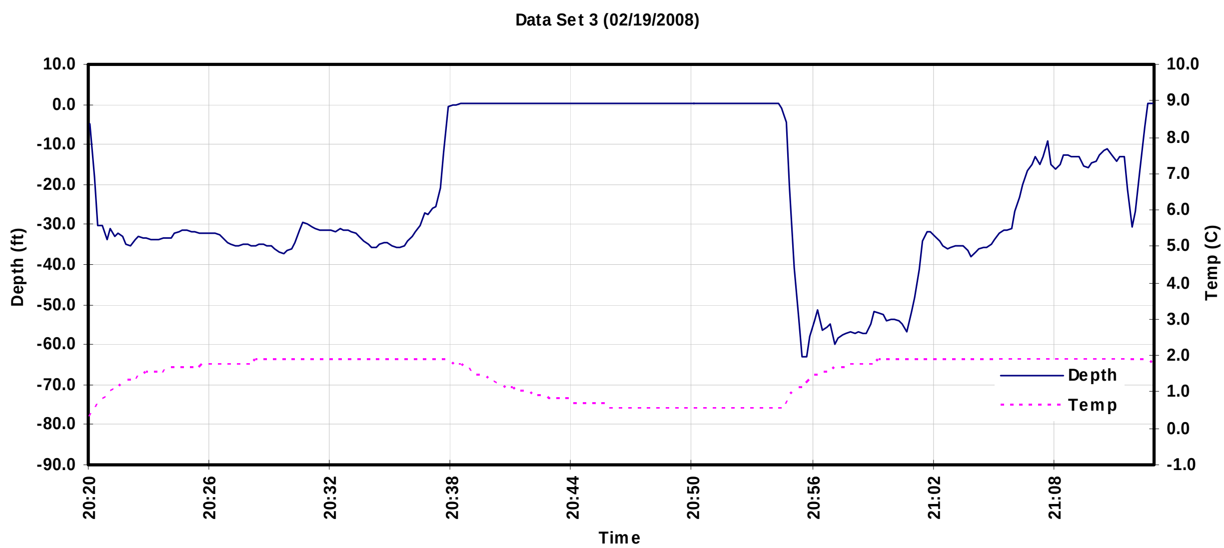


Table 19. Ichthyoplankton sampling data for February 19, 2008 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

DE LNG Ichthyoplankton sampling
19 February 2008
Oblique tows to current direction

Tow Type	Mean Depth (YSI sonde depth @ ~2 ft above net)	Mean Depth (sensor on net, ft/m)	Start time	End time	Total time (min)	Speed over bottom (knots)	Counter start	Counter end	Count difference	Temp (ºC)	Salinity (ppt/psu)	Distance (meters)	Net speed (cm/sec)	Net speed (knots)	Volume (m^3)
AM High water															
Target depth	32.6 / 9.9	34.5 / 10.5	0738	0753	15	1.4-1.5	870673	896375	**25702**	2.0	31.0	690.7	75.2	1.4	**201.7**
Composite	Sample jar temporarily lost - samples discarded														
bottom	52.1 / 15.9	57.8 / 17.6	0814	0819	5	1.3-1.4	896375			2.0	31.1				
target	33.2 / 10.1	31.4 / 9.6	0819	0824	5	1.1-1.7				2.0	31.0				
surface	9.7 / 3.0	10.1 / 3.1	0854	0859	5	1.5		920253	**23878**	2.0	30.4	641.7	73.5	1.4	**187.4**
Composite (2)	Sample jar recovered - samples retaken														
bottom	55.0 / 16.7	56.6 / 17.2	0844	0849	5	1.5	920253			2.0	31.2				
target	33.7 / 10.3	34.2 / 10.4	0849	0854	5	1.7				2.0	31.0				
surface	10.5 / 3.2	11.0 / 3.3	0854	0859	5	1.5		948244	**27991**	2.0	30.5	752.2	84.4	1.6	**219.7**
PM Low water	Very windy - flowmeter props turning rapidly prior to hitting water														
Target depth	33.0 / 10.0	34.8 / 10.6	1319	1334	15	1.7	948244	980854	**32610**	1.9	30.6	876.3	97.4	1.9	**256.0**
Composite															
bottom	52.9 / 16.1	53.4 / 16.3	1359	1404	6	1.5-1.7	982130			2.0	30.9				
target	32.1 / 9.8	32.9 / 10.0	1405	1410	6					1.9	30.6				
surface	12.8 / 3.9	11.4 / 3.5	1410	1415	4			1018833	**36703**	1.9	29.2	986.3	101.8	2.0	**288.1**
Night High water															
Target depth	32.0 / 9.7	33.4 / 10.2	2022	2037	15	1.6	18833	51082	**32249**	2.0	30.9	866.6	99.6	1.9	**253.1**
Composite															
bottom	53.8 / 16.4	55.4 / 16.9	2056	2101	5	1.3-1.5	51082			2.1	31.2				
target	33.0 / 10.0	34.7 / 10.6	2102	2106	5	1.5				2.1	31.0				
surface	12.6 / 3.8	13.6 / 4.1	2107	2112	5	1.5		83614	**32532**	1.9	30.6	874.2	98.8	1.9	**255.4**
										2.0	**Mean**	**789.4**	**86.5**	**1.7**	**230.6**

Table 20. Analysis results of February 19, 2008 ichthyoplankton sampling at Mill Cove, Robbinston, Maine.

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	#/m^3
AM HW target	10	Liparis atlanticus	5		**0.025**
		Myoxocephalus octodecemspinosus	1		**0.005**
		Lumpenus lampretaeformis	1		**0.005**
		Total	**7**	**Larvae/m^3**	**0.035**
		Cod/haddock/witch eggs	1		**0.005**
		Total	**1**	**Eggs/m^3**	**0.005**
AM HW composite	10	Ammodytes	1		**0.005**
		Lumpenus lampretaeformis	1		**0.005**
		Myoxocephalus octodecemspinosus	9		**0.041**
		Liparis atlanticus	15		**0.068**
		Triglops sp.	1		**0.005**
		Total	**27**	**Larvae/m^3**	**0.123**
		Total	**0.000**	**Eggs/m^3**	**0.000**
PM LW target	11	Liparis atlanticus	11		**0.043**
		Myoxocephalus octodecemspinosus	7		**0.027**
		Ammodytes sp.	2		**0.008**
		Triglops sp.	7		**0.027**
		Total	**27**	**Larvae/m^3**	**0.105**
		Pollachius virens eggs	1		**0.004**
		Total	**1**	**Eggs/m^3**	**0.004**
PM LW composite	14	Ammodytes sp.	4		**0.014**
		Lumpenus lampretaeformis	1		**0.003**
		Liparis atlanticus	33		**0.115**
		Myoxocephalus octodecemspinosus	2		**0.007**
		Triglops sp.	8		**0.028**
		Cod/haddock/witch eggs	1		**0.003**
		Total	**49**	**Larvae/m^3**	**0.170**
		unidentifiable eggs (C. harengus?)	1		**0.003**
		Total	**1**	**Eggs/m^3**	**0.003**
night HW target	23	Liparis atlanticus	40		**0.158**
		Myoxocephalus octodecemspinosus	12		**0.047**
		Ammodytes sp.	1		**0.004**
		Triglops sp.	5		**0.020**
		Total	**58**	**Larvae/m^3**	**0.229**
		Pollachius virens eggs	2		**0.008**
		Total	**2**	**Eggs/m^3**	**0.008**

Sample	Plankton volume (ml)	Fish species	# in sample	Larvae/eggs	$\#/m^3$
night HW composite	15	Liparis atlanticus	70		**0.274**
		Myoxocephalus octodecemspinosus	8		**0.031**
		Clupea harengus	2		**0.008**
		Triglops sp.	3		**0.012**
		Total	**83**	**Larvae/m^3**	**0.325**
		Pollachius virens eggs	2		
		unidentifiable eggs (C. harengus?)	2		
		Total	**4**	**Eggs/m^3**	**0.016**

	Eggs	Larvae	m^3 sampled	Eggs $\#/m^3$	Larvae $\#/m^3$
AM LW target	1	7	201.7	0.005	0.035
AM LW comp	0	27	219.7	0.000	0.123
PM HW target	1	27	256.0	0.004	0.105
PM HW comp	1	49	288.1	0.003	0.170
Night LW target	2	58	253.1	0.008	0.229
Night LW comp.	4	83	255.4	0.016	0.325
		Mean	**245.7**	**0.006**	**0.165**

	Larvae loss/winter [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.009**	**0.123**	**1,184,283**	**11.84**	**118.4**
Daily mean	**0.014**	**0.165**	**1,582,894**	**15.83**	**158.3**

	Egg loss/summer [1]		Equivalent adult loss 1/100,000	1/10,000	1/1,000
Target loss	**0.006**	**53,761**	**0.54**	**5.4**	**54**
Daily mean	**0.006**	**57,556**	**0.58**	**5.8**	**58**

[1] **Assumes seawater usage of 211,421m^3/visit and 45.5 vessel visits per winter**

Table 21. Zooplankton Analysis of February 19, 2008 samples by Dr. Ray Gerber, Brunswick, Maine

Species List	AM Low Water Target Depth	AM High Water Multi-depth	PM High Water Target Depth	PM Low Water Multi-depth	Night High Water Multi-depth	Night High Water Target Depth
Calanoid Copepods:						
Acartia hudsonica	50,027	21,066	74,000	33,892	72,427	190,027
Acartia longiremis						
Acartia tonsa						
Calanus finmarchicus	3,220	3,017	3,900	3,733	3,080	3,873
Calanus hyperboreus		17	100	58	93	
Centropages hamatus						
Centropages typicus						
Centropages spp.						
Eurytemora herdmani	3,313	1,133	3,400	1,400	3,127	2,940
Metrida longa						
Metridia lucens						
Microcalanus pusillus						
Paracalanus parvus						
Paraeuchaeta norvegica	1				6	
Pseudocalanus spp.	2,613	733	2,567	3,763	3,360	5,040
Scolecithricella minor						
Temora longicornis	93	50	1,400	963	47	233
Tortanus discaudatus	93	167	2,433	2,625	187	607
Cyclopoid Copepods:						
Oithonia atlantica						
Oithonia similis						
Monstrilloid Copepods						
Harpacticoid Copepods	47		67			
Cladocera:						
Evadne nordmanni						
Pleopis polyphemoides						
Podon leukarti						
Euphausiids:						
Meganyctiphanes norvegica					1	
Thysanoessa inermis					6	
Cumaceans					47	47
Amphipods:						
Caprellids						
Gammarids					4	47
Mysids:						
Erythrops erythrophthalma						1
Mysis stenolepis					3	
Neomysis americana					7	5
Decapods (Carideans):						
Crangon septemspinosa					1	1
Eualus fabricii						

Table 21. Zooplankton Analysis of February 19, 2008 samples by Dr. Ray Gerber, Brunswick, Maine (Cont.)

Species List	AM Low Water Target Depth	AM High Water Multi-depth	PM High Water Target Depth	PM Low Water Multi-depth	Night High Water Multi-depth	Night High Water Target Depth
Decapods (Carideans):						
Lebeus groenlandicus						
Crustacea larvae:						
Cypris larvae						
Decapod larvae						
Megalopa Brachyura)						
Nauplii			33	29	47	
Zoea (Brachyura)						
Parasitic copepods						
Parasitic isopods						
Mollusks:						
Lamellibranch larvae			67	29		
Veliger larvae						
Oligochaetes						
Polychaetes:						
Autolytus prolifera						
Polychaete larvae						
Tomopterus sp.						
Echinoderms:						
Pluteus larvae						
Medusae		17	533	291		93
Chaetognaths:						
Parasagitta elegans	11	5	25	11	19	14
Sample total	**59,433**	**26,222**	**88,625**	**46,823**	**82,470**	**203,068**
m^3 sampled	219.7	201.7	288.1	219.7	255.4	253.1
#/m^3	**270.5**	**130.0**	**307.6**	**213.1**	**323.0**	**802.2**
				Overall mean #/m^3		**341.1**
				Target depth mean #/m^3		**381.8**

Comments on the Zooplankton Data: DE LNG, Mill Cove, Robbinston, Maine
From 02/19/08 (labeled 02/18/08)

Prepared by: Ray P. Gerber Ph.D.
Acadia Productions
P. O. Box 97
Brunswick, Maine 04011

March 4, 2008

General Comments

Sub-sampling was done by taking 3 - 2 ml aliquots of the samples and all the organisms in each subsample were identified and counted. In addition, all large sized zooplankton were picked out of the samples prior to sub-sampling. Samples were thoroughly mixed prior to and during the subsamplings. The counts for the identified species include both the immature and mature stages. All samples were free of debris and this made analysis more accurate and faster.

Most species in the present samples were considerably less abundant than found in the previous fall samples (October 25, 2007). Since night samples were not taken in the previous fall the present night samples cannot be compared. Also, the abundance of nearly all species in the present winter samples was much greater than in samples from the prior winter (February 27, 2007). Most zooplankton and especially the copepods consisted of immature stages. This explains why the adult female zooplankton (copepods) were devoid of attached egg masses. This is typical for late winter zooplankton when food levels (phytoplankton) are at a minimum for the year.

Specific Comments

Acartia hudsonica
Despite its lower abundance (compared to the prior October samples) the copepod *A. hudsonica,* was still the most abundant organism in the samples. *A. hudsonica* was most abundant in the Night High Water Target Depth sample, far exceeding the values from the previous winter. This copepod was least abundant in the AM High Water Target Depth sample and this was also observed for the previous winter.

Calanus species
The second most abundant organism in the samples was the large calanoid copepod, *Calanus finmarchicus.* This pattern was also observed for the prior winter sampling, except *Calanus* was more abundant in the present winter samples. The very large size copepod, *Calanus hyperboreus,* was also found in the present winter samples as it was last winter. It occurred more frequently in the present samples and in more abundance compared to the previous winter. *C. hyperboreus* is a cold water species and commonly occurs in the boreal regions of the Atlantic and in the Gulf of Maine.

Pseudocalanus spp.
This copepod was the third most abundant organism in the present winter samples and it was far more abundant than in the previous winter (February 2007). Two species of the copepod genus *Pseudocalanus* occur along the Maine coast. They consist of *P. neumani* and *P. moultoni* and as described earlier they are difficult to identify to species. The present populations consisted of a few adults and many juvenile stages. None of the adult females were carrying eggs.

Eurytemora herdmanni
The copepod, *Eurytemora,* was almost as abundant as *Pseudocalanus* spp. in the present samples. *Eurytemora* was much more abundant this winter when compared to last winter. This copepod consisted almost entirely of immature stages with only a few adult stages.

Temora longicaudata
This copepod was much more abundant in the present samples than in those from the prior winter. They consistently occurred in all six samples.

Tortanus discaudata
This predatory copepod was occurred in all the present winter samples. Last February, *Tortanus,* was found in only one sample (PM Low Water Multi-depth) and in very low abundance. Curiously, the maximum abundance of *Tortanus* from this winter also occurred in the PM Low Water Multi-depth sample. As indicated previously, the preserved *Tortanus* were often observed holding medusa in its feeding appendages apparently in the act of consuming the medusa.

Centropages hamatus and Centropages typicus
The present winter samples did not reveal either of these two species. In samples from last winter only *C. typicus* was found and it occurred in low abundance. It is unclear why *Centropages* were not found in the present samples.

Oithona similis and *O. atlantica*
These small copepods were not found in the present winter samples. A few *O. atlantica* were found in one sample from last winter.

Paraeuchaeta norvegica
This very large predatory copepod was found in two of the present winter samples. It is not normally found in coastal bays preferring offshore deeper water of the Gulf of Maine. *Paraeuchaeta* was not found in the samples from last winter.

Harpacticoid Copepods
A few of these copepods were found in two of the present winter samples. They appeared to be benthic varieties that perhaps were swept into the water column by ocean currents. They were not found in the previous winter samples.

Cladocera:
None were found in the present samples and none were found in the samples from last winter as well.

Amphipods, Decapods (caridians), Euphausiids, Mysids and Cumaceans
As in previous samples this group of crustacea were most abundant in the two night samples. However, none were found in the day-time samples from this winter. Except for the euphausiids, this group consisted of epibenthic organisms that enter the water column at night. Euphausiids are pelagic zooplankton that are known to vertically migrate at night and are less able to avoid the plankton net at night.

Crustacea larvae:
Except for a few relatively large nauplii no other crustacean larvae were found. In contrast, decapod larvae were found in all the samples from last winter (February 2007).

Medusae:
Medusae were found in four of the six samples and consisted of at least two species, *Obelia sp.* and *Rathkea octopuntata*, with the latter being more common. When they occurred in a sample, they were slightly more abundant compared to the samples from last winter. As noted above many of the medusae were found in the clutches of the copepod *Tortanus discaudatus*.

Chaetognaths:
Parasagitta elegans occurred in all six of the present winter samples though in fairly low abundance. In the previous winter they occurred in only three of the samples and were present in very low abundance. Generally, this chaetognath reaches peak abundances in late summer and early fall in the Gulf of Maine area at a time when it's food supply (copepods) are also abundant.

Lamellibranch larvae:
These are the late larval stage of bivalve mollusks. A few were found in the two PM samples.

Polyhaetes and Polychaete larvae:
None were found in the present samples.

Fish larvae and Fish eggs:
A few fish larvae were found in all six samples with the greatest abundance occurring in the Night High Water Target Depth sample. A few fish larvae were also found in all six samples from last winter though the abundances were a bit lower. No fish eggs were found in the samples from the present samples.

Acarina (water mites)
These small arthropods were found only in a single sample where it was observed clutching a piece of detritus. Water mites are generally rare in marine zooplankton collections.

Summary to-date

Table 22 shows the target depth (32-35 ft.) average density of fish larvae, fish eggs, and zooplankton for each of the sampling periods as well as the average for the winter and summer seasons and the year.

Table 22. Target depth average density of fish larvae, fish eggs, and zooplankton

Month	Fish larvae		Fish eggs		Zooplankton
	By date	By species	By date	By species	By date
October 06	0.047	**See Tables 23, 25, 27,29, 31, 33**	0.000	**See Tables 23, 25, 27,29, 31**	
February 07	0.054		0.004		63
October 07	0.009		0.000		310
February 08	0.123		0.006		382
Seasonal winter average	**0.058**	**0.059**	**0.003**	**0.002**	**252**
Value used in initial impact estimate	**0.137**		**0.019**		**1579**
May 07	0.134	**See Table 24, 26, 28, 30, 32, 34**	0.065	**See Table 24, 26, 28, 30, 32, 34**	2620
August 07	0.052		0.214		3733
September 07	0.013		0.064		1959
Summer average	**0.066**	**0.046**	**0.114**	**0.113**	**2771**
Value used in initial impact estimate	**0.140**		**1.506**		**1579**

Table 23. Winter fish eggs and fish larvae losses by species resulting from 125 Km^3 ship engine cooling

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] $\#/m^3$	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	11,211	11	1	0.1
Cod/haddock/witch flounder	CHW	0.001	42.9	8,408	8	1	0.1
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	19,619	20	2	0
	Highlighted "top-5-occurring" species represent		100.0	19,619	20	2	0
	Commercially important, NEFMC-managed species		100.0	19,619	20	2	0

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] $\#/m^3$	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	104,049	104	10	1.0
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	158,350	158	16	1.6
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	64,461	64	6	0.6
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	86,182	86	9	0.9
Sand lance	*Ammodytes sp.*	0.002	3.0	14,714	15	1	0.1
Sculpin	*Triglops sp.*	0.004	6.6	32,931	33	3	0.3
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	19,969	20	2	0.2
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	2,803	3	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	11,911	12	1	0.1
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	*Unid.*	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	495,370	495	50	5
	Highlighted "top-5-occurring" species represent		90.0	445,973	446	45	4
	Commercially important, NEFMC-managed species		21.0	104,049	116	12	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish

CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 186,844m^3 for a 125Km^3 vessel for time in port over 45.5 visits per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 24. Summer fish eggs and fish larvae losses by species resulting from 125 Km^3 ship engine cooling

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	2,387	2	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	42,974	43	4	0.4
Cunner/yellowtail eggs	CYT	0.004	2.8	16,235	16	2	0.2
	H4B	0.078	58.6	335,198	335	34	3.4
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	155,662	156	16	1.6
Cunner	*Tautogolabrus adspersus*	0.003	2.1	11,937	12	1	0.1
Hake/Codling	*Urophycis sp.*	0.001	0.5	2,865	3	0	0.0
Cod	*Gadus morhua*	0.001	0.5	2,865	3	0	0.0
Unid. eggs	Unid.	0.000	0.3	1,910	2	0	0.0
	Totals	0.133	100.0	572,033	572	57	6
	Highlighted "top-5-occurring" species represent		98.2	562,006	562	56	6
	Commercially important, NEFMC-managed species		30.6	174,761	175	17	2

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	1,910	2	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	1,910	2	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes sp.*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	34,379	34	3	0.3
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	7,162	7	1	0.1
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	3,342	3	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	7,640	8	1	0.1
Unid.	Unid.	0.001	2.9	5,730	6	1	0.1
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	73,533	74	7	0.7
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	39,632	40	4	0.4
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	4,775	5	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	12,892	13	1	0.1
Cunner	*Tautogolabrus adspersus*	0.001	1.9	3,820	4	0	0.0
	Totals	0.046	100.0	196,726	197	20	2
	Highlighted "top-5-occurring" species represent		85.4	168,077	168	17	2
	Commercially important, NEFMC-managed species		47.3	93,111	93	9	1

75	Total annual fish loss[7]
23	Total annual commercially-important fish loss[7]

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish

CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 186,844 m^3 for a 125Km^3 vessel for time in port over 22.8 visits per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 25. Winter fish eggs and fish larvae losses by species resulting from 138 Km^3 ship engine cooling

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] $\#/m^3$	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	12,006	12	1	0.1
Cod/haddock/witch flounder	CHW	0.001	42.9	9,005	9	1	0.1
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	21,011	21	2	0
	Highlighted "top-5-occurring" species represent		100.0	21,011	21	2	0
	Commercially important, NEFMC-managed species		100.0	21,011	21	2	0

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] $\#/m^3$	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	111,435	111	11	1.1
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	169,591	170	17	1.7
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	69,037	69	7	0.7
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	92,299	92	9	0.9
Sand lance	*Ammodytes sp.*	0.002	3.0	15,758	16	2	0.2
Sculpin	*Triglops sp.*	0.004	6.6	35,269	35	4	0.4
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	21,386	21	2	0.2
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	3,002	3	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	12,757	13	1	0.1
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	Unid.	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	530,534	531	53	5
	Highlighted "top-5-occurring" species represent		90.0	477,630	478	48	5
	Commercially important, NEFMC-managed species		21.0	124,191	124	12	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish
CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 200,107 m^3 for a 138Km^3 vessel for time in port over 45.5 visits per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 26. Summer fish eggs and fish larvae losses by species resulting from 138 Km^3 ship engine cooling

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Egg Loss					
		Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	2,557	3	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	46,025	46	5	0.5
Cunner/yellowtail eggs	CYT	0.004	2.8	17,387	17	2	0.2
	H4B	0.078	58.6	358,992	359	36	3.6
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	166,711	167	17	1.7
Cunner	*Tautogolabrus adspersus*	0.003	2.1	12,785	13	1	0.1
Hake/Codling	*Urophycis sp.*	0.001	0.5	3,068	3	0	0.0
Cod	*Gadus morhua*	0.001	0.5	3,068	3	0	0.0
Unid. eggs	Unid.	0.000	0.3	2,046	2	0	0.0
	Totals	0.133	100.0	612,639	613	61	6
	Highlighted "top-5-occurring" species represent		98.2	601,900	602	60	6
	Commercially important, NEFMC-managed species		30.6	187,167	187	19	2

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Larvae loss					
		Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	2,046	2	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	2,046	2	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes sp.*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	36,820	37	4	0.4
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	7,671	8	1	0.1
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	3,580	4	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	8,182	8	1	0.1
Unid.	Unid.	0.001	2.9	6,137	6	1	0.1
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	78,753	79	8	0.8
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	42,445	42	4	0.4
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	5,114	5	1	0.1
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	13,807	14	1	0.1
Cunner	*Tautogolabrus adspersus*	0.001	1.9	4,091	4	0	0.0
	Totals	0.046	100.0	210,690	211	21	2
	Highlighted "top-5-occurring" species represent		85.4	180,007	180	18	2
	Commercially important, NEFMC-managed species		47.3	99,720	100	10	1

80	Total annual fish loss[7]
24	Total annual commercially-important fish loss[7]

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish

CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 200,107 m^3 for a 138Km^3 vessel for time in port over 22.8 visits per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 27. Winter fish eggs and fish larvae losses by species resulting from 145 Km^3 ship engine cooling

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	12,685	13	1	0.1
Cod/haddock/witch flounder	CHW	0.001	42.9	9,514	10	1	0.1
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	22,199	22	2	0
	Highlighted "top-5-occurring" species represent		100.0	22,199	22	2	0
	Commercially important, NEFMC-managed species		100.0	22,199	22	2	0

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	117,734	118	12	1.2
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	179,178	179	18	1.8
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	72,940	73	7	0.7
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	97,517	98	10	1.0
Sand lance	*Ammodytes sp.*	0.002	3.0	16,649	17	2	0.2
Sculpin	*Triglops sp.*	0.004	6.6	37,263	37	4	0.4
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	22,595	23	2	0.2
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	3,171	3	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	13,478	13	1	0.1
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	Unid.	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	560,525	561	56	6
	Highlighted "top-5-occurring" species represent		90.0	504,631	505	50	5
	Commercially important, NEFMC-managed species		21.0	131,212	131	13	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish
CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 211,419 m^3 for a 145Km^3 vessel for time in port over 45.5 visits per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 28. Summer fish eggs and fish larvae losses by species resulting from 145 Km^3 ship engine cooling

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	2,701	3	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	48,626	49	5	0.5
Cunner/yellowtail eggs	CYT	0.004	2.8	18,370	18	2	0.2
	H4B	0.078	58.6	379,286	379	38	3.8
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	176,136	176	18	1.8
Cunner	*Tautogolabrus adspersus*	0.003	2.1	13,507	14	1	0.1
Hake/Codling	*Urophycis sp.*	0.001	0.5	3,242	3	0	0.0
Cod	*Gadus morhua*	0.001	0.5	3,242	3	0	0.0
Unid. eggs	Unid.	0.000	0.3	2,161	2	0	0.0
	Totals	0.133	100.0	647,271	647	65	6
	Highlighted "top-5-occurring" species represent		98.2	635,925	636	64	6
	Commercially important, NEFMC-managed species		30.6	197,747	198	20	2

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	2,161	2	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	2,161	2	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes sp.*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	38,901	39	4	0.4
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	8,104	8	1	0.1
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	3,782	4	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	8,645	9	1	0.1
Unid.	Unid.	0.001	2.9	6,484	6	1	0.1
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	83,205	83	8	0.8
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	44,844	45	4	0.4
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	5,403	5	1	0.1
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	14,588	15	1	0.1
Cunner	*Tautogolabrus adspersus*	0.001	1.9	4,322	4	0	0.0
	Totals	0.046	100.0	222,601	223	22	2
	Highlighted "top-5-occurring" species represent		85.4	190,183	190	19	2
	Commercially important, NEFMC-managed species		47.3	105,357	105	11	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish — 85 Total annual fish loss[7]

CYT - cunner/yellowtail — 26 Total annual commercially-important fish loss[7]

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 211,419 m^3 for a 145Km^3 vessel for time in port over 22.8 visits per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 29. Winter fish eggs and fish larvae losses by species resulting from 165 Km^3 ship engine cooling

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	4,516	5	0	0.0
Cod/haddock/witch flounder	CHW	0.001	42.9	3,387	3	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	7,902	8	1	0
	Highlighted "top-5-occurring" species represent		100.0	7,902	8	1	0
	Commercially important, NEFMC-managed species		100.0	7,902	8	1	0

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	41,910	42	4	0.4
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	63,782	64	6	0.6
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	25,964	26	3	0.3
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	34,713	35	3	0.3
Sand lance	*Ammodytes sp.*	0.002	3.0	5,927	6	1	0.1
Sculpin	*Triglops sp.*	0.004	6.6	13,264	13	1	0.1
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	8,043	8	1	0.1
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	1,129	1	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	4,798	5	0	0.0
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	Unid.	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	199,530	200	20	2
	Highlighted "top-5-occurring" species represent		90.0	179,634	180	18	2
	Commercially important, NEFMC-managed species		21.0	46,708	47	5	0

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish
CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 75,259 m^3 for a 165Km^3 vessel for time in port over 45.5 visits per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 30. Summer fish eggs and fish larvae losses by species resulting from 165 Km³ ship engine cooling

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Egg Loss					
		Mean[1] #/m³	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	962	1	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	17,310	17	2	0.2
Cunner/yellowtail eggs	CYT	0.004	2.8	6,539	7	1	0.1
	H4B	0.078	58.6	135,015	135	14	1.4
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	62,699	63	6	0.6
Cunner	*Tautogolabrus adspersus*	0.003	2.1	4,808	5	0	0.0
Hake/Codling	*Urophycis sp.*	0.001	0.5	1,154	1	0	0.0
Cod	*Gadus morhua*	0.001	0.5	1,154	1	0	0.0
Unid. eggs	Unid.	0.000	0.3	769	1	0	0.0
	Totals	0.133	100.0	230,410	230	23	2
	Highlighted "top-5-occurring" species represent		98.2	226,371	226	23	2
	Commercially important, NEFMC-managed species		30.6	70,392	70	7	1

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Larvae loss					
		Mean[1] #/m³	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	769	1	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	769	1	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes sp.*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	13,848	14	1	0.1
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	2,885	3	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	1,346	1	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	3,077	3	0	0.0
Unid.	Unid.	0.001	2.9	2,308	2	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	29,619	30	3	0.3
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	15,963	16	2	0.2
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	1,923	2	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	5,193	5	1	0.1
Cunner	*Tautogolabrus adspersus*	0.001	1.9	1,539	2	0	0.0
	Totals	0.046	100.0	79,239	79	8	1
	Highlighted "top-5-occurring" species represent		85.4	67,700	68	7	1
	Commercially important, NEFMC-managed species		47.3	37,504	38	4	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish	30	Total annual fish loss[7]
CYT - cunner/yellowtail	9	Total annual commercially-important fish loss[7]

[1] Mean number of eggs or fish larvae for species per m³ for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 75,259 m³ for a 165Km³ vessel for time in port over 22.8 visits per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 31. Winter fish eggs and fish larvae losses by species resulting from 200 Km^3 ship engine cooling

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	5,340	5	1	0.1
Cod/haddock/witch flounder	CHW	0.001	42.9	4,005	4	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	9,345	9	1	0
	Highlighted "top-5-occurring" species represent		100.0	9,345	9	1	0
	Commercially important, NEFMC-managed species		100.0	9,345	9	1	0

Ship cooling mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	49,560	50	5	0.5
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	75,424	75	8	0.8
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	30,704	31	3	0.3
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	41,049	41	4	0.4
Sand lance	*Ammodytes sp.*	0.002	3.0	7,008	7	1	0.1
Sculpin	*Triglops sp.*	0.004	6.6	15,686	16	2	0.2
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	9,511	10	1	0.1
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	1,335	1	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	5,673	6	1	0.1
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	Unid.	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	235,951	236	24	2
	Highlighted "top-5-occurring" species represent		90.0	212,422	212	21	2
	Commercially important, NEFMC-managed species		21.0	55,233	55	6	1

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish
CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 88,996 m^3 for a 200Km^3 vessel for time in port over 45.5 visits per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 32. Summer fish eggs and fish larvae losses by species resulting from 200 Km^3 ship engine cooling

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	1,137	1	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	20,469	20	2	0.2
Cunner/yellowtail eggs	CYT	0.004	2.8	7,733	8	1	0.1
	H4B	0.078	58.6	159,659	160	16	1.6
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	74,144	74	7	0.7
Cunner	*Tautogolabrus adspersus*	0.003	2.1	5,686	6	1	0.1
Hake/Codling	*Urophycis sp.*	0.001	0.5	1,365	1	0	0.0
Cod	*Gadus morhua*	0.001	0.5	1,365	1	0	0.0
Unid. eggs	Unid.	0.000	0.3	910	1	0	0.0
	Totals	0.133	100.0	272,466	272	27	3
	Highlighted "top-5-occurring" species represent		98.2	267,690	268	27	3
	Commercially important, NEFMC-managed species		30.6	83,241	83	8	1

Ship cooling mean summer losses based on May, Aug, and Sept 07 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per summer[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	910	1	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	910	1	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sand lance	*Ammodytes sp.*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	16,375	16	2	0.2
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	3,412	3	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	1,592	2	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	3,639	4	0	0.0
Unid.	Unid.	0.001	2.9	2,729	3	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	35,025	35	4	0.4
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	18,877	19	2	0.2
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	2,274	2	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	6,141	6	1	0.1
Cunner	*Tautogolabrus adspersus*	0.001	1.9	1,819	2	0	0.0
	Totals	0.046	100.0	93,703	94	9	1
	Highlighted "top-5-occurring" species represent		85.4	80,057	80	8	1
	Commercially important, NEFMC-managed species		47.3	44,350	44	4	0

H4B - *Urophycis* sp. [hake], fourbeard rockling, windowpane, butterfish — 36 — Total annual fish loss[7]

CYT - cunner/yellowtail — 11 — Total annual commercially-important fish loss[7]

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 88,996 m^3 for a 200Km^3 vessel for time in port over 22.8 visits per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 33. Winter fish eggs and fish larvae losses by species resulting from fire suppression tests

Fire suppression mean winter losses based on October 06, 07 and February 07, 08 data		Egg Loss: Mean[1] #/m³	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.001	57.1	165	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	42.9	124	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.000	0.0	0	0	0	0.0
Cunner/yellowtail eggs	CYT	0.000	0.0	0	0	0	0.0
	H4B	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.000	0.0	0	0	0	0.0
Cod	*Gadus morhua*	0.000	0.0	0	0	0	0.0
Unid. eggs	Unid.	0.000	0.0	0	0	0	0.0
	Totals	0.002	100.0	289	0	0	0
	Highlighted "top-5-occurring" species represent		100.0	289	0	0	0
	Commercially important, NEFMC-managed species		100.0	289	0	0	0

Fire suppression mean winter losses based on October 06, 07 and February 07, 08 data		Larvae loss: Mean[1] #/m³	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.012	21.0	1,534	2	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.019	32.0	2,335	2	0	0.0
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.008	13.0	951	1	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.010	17.4	1,271	1	0	0.0
Sand lance	*Ammodytes sp.*	0.002	3.0	217	0	0	0.0
Sculpin	*Triglops sp.*	0.004	6.6	486	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.002	4.0	294	0	0	0.0
Atlantic seasnail	*Liparis inquillinus*	0.000	0.6	41	0	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.001	2.4	176	0	0	0.0
Capelin	*Mallotus villosus*	0.000	0.0	0	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.000	0.0	0	0	0	0.0
Unid.	Unid.	0.000	0.0	0	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.000	0.0	0	0	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.000	0.0	0	0	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.000	0.0	0	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.000	0.0	0	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.000	0.0	0	0	0	0.0
	Totals	0.059	100.0	7,305	7	1	0
	Highlighted "top-5-occurring" species represent		90.0	6,577	7	1	0
	Commercially important, NEFMC-managed species		21.0	1,534	2	0	0

H4B - Hake, fourbeard rockling, windowpane, butterfish

CYT - cunner/yellowtail

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[2] Loss per winter assumes maximum flow rate of 4,769 m^3 per weekly test and 26 tests per winter

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

Table 34. Summer fish eggs and fish larvae losses by species resulting from fire suppression tests

Fire suppression mean summer losses based on May, Aug, and Sept 07 data		Egg Loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	0.0	0	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	0.0	0	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Pollack	*Pollachius virens*	0.000	0.0	0	0	0	0.0
Cod/haddock/witch flounder	CHW	0.001	0.4	69	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.010	7.5	1,240	1	0	0.0
Cunner/yellowtail eggs	CYT	0.004	2.8	468	0	0	0.0
	H4B	0.078	58.6	9,672	10	1	0.1
Windowpane flounder	*Scophthalmus aquosus*	0.036	27.2	4,491	4	0	0.0
Cunner	*Tautogolabrus adspersus*	0.003	2.1	344	0	0	0.0
Hake/Codling	*Urophycis sp.*	0.001	0.5	83	0	0	0.0
Cod	*Gadus morhua*	0.001	0.5	83	0	0	0.0
Unid. eggs	Unid.	0.000	0.3	55	0	0	0.0
	Totals	0.133	100.0	16,505	17	2	0
	Highlighted "top-5-occurring" species represent		98.2	16,216	16	1	0
	Commercially important, NEFMC-managed species		89.1	14,714	5	1	0

Fire suppression mean summer losses based on May, Aug, and Sept 07 data		Larvae loss: Mean[1] #/m^3	% of total	Loss per winter[2]	Loss @ 1/1,000 survival rate[3]	Loss @ 1/10,000 survival rate[4]	Loss @ 1/100,000 survival rate[5]
Herring	*Clupea harengus*	0.000	1.0	55	0	0	0.0
Atlantic seasnail	*Liparis atlanticus*	0.000	1.0	55	0	0	0.0
Snake blenny	*Lumpenus lampretaeformis*	0.000	0.0	0	0	0	0.0
Sculpin	*Triglops sp.*	0.000	0.0	0	0	0	0.0
Four-beard rockling	*Enchelyopus cimbrius*	0.008	17.5	992	1	0	0.0
Atlantic seasnail	*Liparis inquillinus*	0.002	3.6	207	0	0	0.0
Haddock	*Melanogrammus aeglefinus*	0.000	0.0	0	0	0	0.0
Capelin	*Mallotus villosus*	0.001	1.7	96	0	0	0.0
Little sculpin	*Myoxocephalus aeneus*	0.002	3.9	220	0	0	0.0
Unid.	Unid.	0.001	2.9	165	0	0	0.0
Winter flounder	*Pseudopleuronectes americanus*	0.017	37.4	2,122	2	0	0.0
Radiated shanny	*Ulvaria subbifurcata*	0.009	20.1	1,144	1	0	0.0
Witch flounder	*Glyptocephalus cynoglossus*	0.001	2.4	138	0	0	0.0
Windowpane flounder	*Scophthalmus aquosus*	0.003	6.6	372	0	0	0.0
Cunner	*Tautogolabrus adspersus*	0.001	1.9	110	0	0	0.0
	Totals	0.046	100.0	5,676	6	1	0
	Highlighted "top-5-occurring" species represent		85.4	4,836	5	0	0
	Commercially important, NEFMC-managed species		47.3	2,687	3	0	0

H4B - Hake, fourbeard rockling, windowpane, butterfish

CYT - cunner/yellowtail

1	Total annual fish loss[7]
0	Total annual commercially-important fish loss[7]
87	Combined Total annual fish loss[7]
26	Combined Total annual commercially-important fish loss[7]

[1] Mean number of eggs or fish larvae for species per m^3 for season based on sampling in Mill Cove

[3] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 1,000 eggs or larvae

[4] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 10,000 eggs or larvae

[5] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs or larvae

[6] Loss per summer assumes maximum flow rate of 4,769 m^3 per weekly test and 26 tests per summer

[7] Total equivalent loss of adult fish assuming a survival rate of 1 fish: 100,000 eggs and 1 fish: 10,000 larvae

Table 35. Fish eggs, fish larvae and zooplankton losses per visit resulting from ship cooling seawater usage based on worst-case values

Per day (Worst case)

Full load ballast

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Max. Fish eggs[8] (#/m^3)	Total fish egg loss/visit[9]	Max. Ichthy.[10] (#/m^3)	Total ichthyo loss/visit[11]	Max. Zooplankton (#/m^3) [13]	Total zooplankton loss/visit[14]
125K MT	6,341	21	53,683	186,835	0.0580%	0.0129%	0.214	39,983	0.134	25,036	3733	697,455,704
138K MT	7,000	21	53,107	200,107	0.0621%	0.0138%	0.214	42,823	0.134	26,814	3733	746,999,431
145K MT	7,355	21	56,964	211,421	0.0657%	0.0146%	0.214	45,244	0.134	28,330	3733	789,232,808
165K MT	500	21	64,759	75,259	0.0234%	0.0052%	0.214	16,105	0.134	10,085	3733	280,941,847
200K MT	500	21	78,496	88,996	0.0276%	0.0061%	0.214	19,045	0.134	11,925	3733	332,222,068

Light load ballast (80.8% of full load ballast)

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Max. Fish eggs[8] (#/m^3)	Total fish egg loss/visit[9]	Max. Ichthy.[10] (#/m^3)	Total ichthyo loss/visit[11]	Max. Zooplanton[13] (#/m^3)	Total zooplankton loss/visit[14]
125K MT	6,341	21	43,372	176,524	0.0548%	0.0122%	0.214	37,776	0.134	23,654	3733	658,964,741
138K MT	7,000	21	42,910	189,910	0.0590%	0.0131%	0.214	40,641	0.134	25,448	3733	708,935,732
145K MT	7,355	21	46,027	200,483	0.0623%	0.0138%	0.214	42,903	0.134	26,865	3733	748,404,658
165K MT	500	21	52,325	62,825	0.0195%	0.0043%	0.214	13,445	0.134	8,419	3733	234,526,740
200K MT	500	21	63,425	73,925	0.0230%	0.0051%	0.214	15,820	0.134	9,906	3733	275,961,159

[1] **Ship size class in thousands of metric tons**

[2] **Flow rate source: John Egan, Marine Master, personal communication 2006**

[3] **Estimated time in port/at dock: John Egan, Marine Master, personal communication 2006**

[4] **Ballast volume source: John Egan, Marine Master, personal communication 2006**

[5] **Total seawater usage per visit = cooling flow rate x time in port + ballast volume**

[6] **Mean tidal flow across line from St. Andrews, New Brunswick and Lewis Cove, Robbinston, Maine - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27**

[7] **Mean ebb and flood tidal flow in and out of Passamaquoddy Bay through Western Passage - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27**

[8] **Based on maximum October 2006- February 2008 fish egg sampling in Mill Cove (August 2007)**

[9] **Mill Cove annual maximum total fish egg count multiplied by total visit seawater usage**

[10] **Based on maximum October 2006- February 2008 ichthyoplankton sampling in Mill Cove (May 2007)**

[11] **Mill Cove annual maximum ichthyoplankton count multiplied by Total visit seawater usage**

[12] **Fisheries stock impact calculated from total ichthyoplankton loss multiplied by the average natural survival rate of larvae to 1-year fish**

[13] **Based on maximum October 2006- February 2008 zooplankton sampling in Mill Cove (August 2007)**

[14] **Mill Cove annual maximum total zooplankton count multiplied by total visit seawater usage**

Table 36. Fish eggs, fish larvae and zooplankton losses per visit resulting from fire suppression system testing based on worst-case values

Fire suppression (Worst case)

Number Fire pumps	Pump flow rate (gpm)	Total test flow rate[1] (m^3/hr)	Test period (hrs)	Total test volume[2] (m^3)	Max. Fish eggs[3] (#/m^3)	Total fish egg loss/test[4]	Total fish egg loss/year[5]	Max. Ichthy.[6] (#/m^3)	Total ichthy. loss/test[7]	Total ichthy. loss/year[8]	Max. Zooplankton[9] (#/m^3)	Total zooplankton loss[10]	Total zooplankton loss[11]
7	3,000	4,769	1	4,769	0.214	**1,021**	**53,071**	0.134	**639**	**33,231**	3733	**17,803,050**	**925,758,616**

[1] Total test flow rate (m3/hr) = ((((Pump flow rate (gpm) * 7) * 60min)*3.785 l/gal)/1000 l/m3

[2] Total test volume = Total test flow rate * Test period

[3] Based on maximum October 2006- February 2008 fish egg sampling in Mill Cove (August 2007)

[4] Mill Cove annual worst case total fish egg count multiplied by total test volume

[5] Total fish egg loss/test * 52 tests/year

[6] Based on maximum October 2006- February 2008 ichthyoplankton sampling in Mill Cove (May 2007)

[7] Mill Cove annual worst case total ichthyoplankton count multiplied by total test volume

[8] Total ichthyoplankton loss/test * 52 tests/year

[9] Based on maximum October 2006- February 2008 zooplankton sampling in Mill Cove (August 2007)

[10] Mill Cove annual worst case zooplankton count multiplied by Total test volume

[11] Total zooplankton loss/test * 52 tests/year

Table 37. Winter fish eggs, fish larvae and zooplankton losses resulting from ship cooling seawater usage based on worst-case values

Winter 4-day visit schedule based on winter eggs and larvae and 45.5 visits per winter

Full load ballast

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Mean Fish eggs[8] (#/m^3)	Total fish egg loss/winter[9]	Mean Ichthy.[10] (#/m^3)	Total ichthyo loss/winter[11]	Average stock impact per winter based on natural larval survival[12]	Mean zooplankton[13] (#/m^3)	Total zooplankton loss/winter[14]
125K MT	6,341	21	53,683	186,835	0.0083%	0.0018%	0.002	19,836	0.059	500,851	See Table 23	252	2.14E+09
138K MT	7,000	21	53,107	200,107	0.0089%	0.0020%	0.002	21,245	0.059	536,429	See Table 23	252	2.29E+09
145K MT	7,355	21	56,964	211,421	0.0094%	0.0021%	0.002	22,446	0.059	566,757	See Table 23	252	2.42E+09
165K MT	500	21	64,759	75,259	0.0033%	0.0007%	0.002	7,990	0.059	201,747	See Table 23	252	8.63E+08
200K MT	500	21	78,496	88,996	0.0039%	0.0009%	0.002	9,448	0.059	238,572	See Table 23	252	1.02E+09

Light load ballast (80.8% of full load ballast)

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Mean Fish eggs[8] (#/m^3)	Total fish egg loss/winter[9]	Mean Ichthy.[10] (#/m^3)	Total ichthyo loss/winter[11]	Average stock impact per winter based on natural larval survival[12]	Mean zooplanton[13] (#/m^3)	Total zooplankton loss/winter[14]
125K MT	6,341	21	43,372	176,524	0.0078%	0.0017%	0.002	18,741	0.059	473,210	See Table 23	252	2.02E+09
138K MT	7,000	21	42,910	189,910	0.0084%	0.0019%	0.002	20,162	0.059	509,095	See Table 23	252	2.18E+09
145K MT	7,355	21	46,027	200,483	0.0089%	0.0020%	0.002	21,285	0.059	537,438	See Table 23	252	2.30E+09
165K MT	500	21	52,325	62,825	0.0028%	0.0006%	0.002	6,670	0.059	168,416	See Table 23	252	7.20E+08
200K MT	500	21	63,425	73,925	0.0033%	0.0007%	0.002	7,848	0.059	198,171	See Table 23	252	8.48E+08

1 Ship size class in thousands of metric tons

2 Flow rate source: John Egan, Marine Master, personal communication 2006

3 Estimated time in port/at dock: John Egan, Marine Master, personal communication 2006

4 Ballast volume source: John Egan, Marine Master, personal communication 2006

5 Total seawater usage per visit = cooling flow rate x time in port + ballast volume

6 Mean tidal flow across line from St. Andrews, New Brunswick and Lewis Cove, Robbinston, Maine - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27; Percentage is percent of total area 4-day flow the total ship-related seawater usage represents

7 Mean ebb and flood tidal flow in and out of Passamaquoddy Bay through Western Passage - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27; Percentage is percent of Total 4-day Passamaquoddy Bay flow the total ship-related seawater usage represents

8 Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 fish egg sampling data for Mill Cove

9 Total winter season egg loss based on Mill Cove winter season mean fish egg count multiplied by total winter seawater usage

10 Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 ichthyoplankton sampling data for Mill Cove

11 Total winter-season ichthyoplankton loss based on Mill Cove winter season mean ichthyoplankton count times total winter seawater usage

12 Fisheries stock impact calculated from Total ichthyoplankton loss multiplied by the average natural survival rate of larvae to 1-year fish

13 Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 zooplankton sampling data for Mill Cove

14 Seasonal Mill Cove mean zooplankton count multiplied by total winter seawater usage

Table 38. Winter fish eggs, fish larvae and zooplankton losses resulting from fire suppression under using worst-case values

Fire suppression (Winter)

Number Fire pumps	Pump flow rate (gpm)	Total test flow rate[1] (m^3/hr)	Test period (hrs)	Total test volume[2] (m^3)	Mean Fish eggs[3] (#/m^3)	Total fish egg loss/test[4]	Total fish egg loss/winter[5]	Mean Ichthy.[6] (#/m^3)	Total ichthy. loss/test[7]	Total ichthy. loss/winter[8]	Mean Zooplankton[9] (#/m^3)	Total zooplankton loss[10]	Total zooplankton loss[11]
7	3,000	4,769	1	4,769	0.002	**11**	**289**	0.059	**281**	**7,305**	252	**1,201,813**	**31,247,143**

[1] Total test flow rate (m^3/hr) = ((((Pump flow rate (gpm) * 7) * 60min)*3.785 l/gal)/1000 l/m^3

[2] Total test volume = Total test flow rate * Test period

[3] Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 fish egg sampling data for Mill Cove

[4] Seasonal Mill Cove mean total fish egg count multiplied by total test volume

[5] Total fish egg loss/test * 52 tests/year

[6] Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 ichthyoplankton sampling data for Mill Cove

[7] Seasonal Mill Cove mean total ichthyoplankton count multiplied by total test volume

[8] Total ichthyoplankton loss/test * 52 tests/year

[9] Based on mean seasonal values of October 2006 and 2007 and February 2007 and 2008 zooplankton sampling data for Mill Cove

[10] Seasonal Mill Cove mean zooplankton count multiplied by total test volume

[11] Total zooplankton loss/test * 52 tests/year

Table 39. Summer fish eggs, fish larvae and zooplankton losses resulting from ship cooling seawater usage based on worst-case values

Summer 8-day visit schedule based on summer egg and larvae and 22.8 visits per summer

Full load ballast

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Mean Fish eggs[8] (#/m^3)	Total fish egg loss/ summer[9]	Mean Ichthy.[10] (#/m^3)	Total ichthyo loss/summer[11]	Average stock impact per summer based on natural larval survival[12]	Mean zooplankton[13] (#/m^3)	Total zooplankton loss/summer[14]
125K MT	6,341	21	53,683	186,835	0.0041%	0.0009%	0.133	567,032	0.051	217,725	See Table 24	2771	1.18E+10
138K MT	7,000	21	53,107	200,107	0.0044%	0.0010%	0.133	607,311	0.051	233,191	See Table 24	2771	1.26E+10
145K MT	7,355	21	56,964	211,421	0.0047%	0.0010%	0.133	641,647	0.051	246,375	See Table 24	2771	1.34E+10
165K MT	500	21	64,759	75,259	0.0017%	0.0004%	0.133	228,406	0.051	87,702	See Table 24	2771	4.75E+09
200K MT	500	21	78,496	88,996	0.0020%	0.0004%	0.133	270,097	0.051	103,710	See Table 24	2771	5.62E+09

Light load ballast (80.8% of full load ballast)

Ship class[1]	Cooling flow rate [2] (m^3/hr)	Time in port [3] (hrs)	Ballast volume[4] (m^3)	Total seawater useage/visit[5] (m^3)	% of Total area flow[6] ($322x10^6$ m^3)	% of Total regional flow[7] ($1452x10^6$ m^3)	Mean Fish eggs[8] (#/m^3)	Total fish egg loss/summer[9]	Mean Ichthy.[10] (#/m^3)	Total ichthyo loss/summer[11]	Average stock impact per summer based on natural larval survival[12]	Mean zooplankton[13] (#/m^3)	Total zooplankton loss/summer[14]
125K MT	6,341	21	43,372	176,524	0.0039%	0.0009%	0.133	535,739	0.051	205,710	See Table 24	2771	1.12E+10
138K MT	7,000	21	42,910	189,910	0.0042%	0.0009%	0.133	576,366	0.051	221,309	See Table 24	2771	1.20E+10
145K MT	7,355	21	46,027	200,483	0.0044%	0.0010%	0.133	608,454	0.051	233,630	See Table 24	2771	1.27E+10
165K MT	500	21	52,325	62,825	0.0014%	0.0003%	0.133	190,671	0.051	73,212	See Table 24	2771	3.97E+09
200K MT	500	21	63,425	73,925	0.0016%	0.0004%	0.133	224,357	0.051	86,147	See Table 24	2771	4.67E+09

1 Ship size class in thousands of metric tons

2 Flow rate source: John Egan, Marine Master, personal communication 2006

3 Estimated time in port/at dock: John Egan, Marine Master, personal communication 2006

4 Ballast volume source: John Egan, Marine Master, personal communication 2006

5 Total seawater usage per visit = cooling flow rate x time in port + ballast volume

6 Mean tidal flow across line from St. Andrews, New Brunswick and Lewis Cove, Robbinston, Maine - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27; Percentage is percent of total area 4-day flow the Total ship-related seawater usage represents

7 Mean ebb and flood tidal flow in and out of Passamaquoddy Bay through Western Passage - W.F. Baird & Associates, July 6, 2006, Table 6.1, p. 27; Percentage is percent of Total 4-day Passamaquoddy Bay flow the total ship-related seawater usage represents

8 Based on mean seasonal values of May, August, September and October 2007 fish egg sampling data for Mill Cove

9 Total winter season egg loss based on Mill Cove winter season mean fish egg count multiplied by total summer seawater usage

10 Based on mean seasonal values of May, August, September and October 2007 fish egg and ichthyoplankton sampling data for Mill Cove

11 Total winter-season ichthyoplankton loss based on Mill Cove summer season mean ichthyoplankton count times total summer seawater usage

12 Fisheries stock impact calculated from Total ichthyoplankton loss multiplied by the average natural survival rate of larvae to 1-year fish

13 Based on mean seasonal values of May, August, September and October 2007 zooplankton sampling data for Mill Cove

14 Seasonal Mill Cove mean zooplankton count multiplied by total summer seawater usage

Table 40. Summer fish eggs, fish larvae and zooplankton losses resulting from fire suppression under using worst-case values

Fire suppression (Summer)

Number Fire pumps	Pump flow rate (gpm)	Total test flow rate[1] (m^3/hr)	Test period (hrs)	Total test volume[2] (m^3)	Mean Fish eggs[3] (#/m^3)	Total fish egg loss/test[4]	Total fish egg loss/ summer[5]	Mean Ichthy.[6] (#/m^3)	Total ichthy. loss/test[7]	Total ichthy. loss/summer[8]	Mean zooplankton[9] (#/m^3)	Total zooplankton loss[10]	Total zooplankton loss/summer[11]
7	3,000	4,769	1	4,769	0.133	**635**	**16,505**	0.051	**244**	**6,338**	2771	**13,215,176**	**343,594,579**

1 Total test flow rate (m^3/hr) = ((((Pump flow rate (gpm) * 7) * 60min)*3.785 l/gal)/1000 l/m^3
2 Total test volume = Total test flow rate * Test period
3 Based on mean seasonal values of May, August, September and October 2007 fish egg sampling data for Mill Cove
4 Seasonal Mill Cove mean fish egg count multiplied by total test volume
5 Total fish egg loss/test * 52 tests/year
6 Based on mean seasonal values of May, August, September and October 2007 ichthyoplankton sampling data for Mill Cove
7 Seasonal Mill Cove mean ichthyoplankton count multiplied by total test volume
8 Total ichthyoplankton loss/test * 52 tests/year
9 Based on mean seasonal values of May, August, September and October 2007 zooplankton sampling data for Mill Cove
10 Seasonal Mill Cove mean zooplankton count multiplied by total test volume
11 Total zooplankton loss/test * 52 tests/year

WOODLOT ALTERNATIVES, INC.
ENVIRONMENTAL CONSULTANTS

Memorandum

To: Downeast LNG, Inc – Robert Wyatt

From: Michael Chelminski, PE

Cc: Gino Giumarro

Date: April 4, 2007

Re: Preliminary Mixing Analysis of Engine Cooling Water Discharges

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Introduction

A preliminary evaluation was performed to evaluate potential effects associated with engine cooling water discharges from vessels moored at the proposed Downeast LNG Pier. This evaluation was performed using the Cornell Mixing Zone Experts System (CORMIX) software. The purpose of this evaluation was to evaluate general parameters associated with mixing of thermal discharges.

General Site Conditions

The evaluation performed here considers the case of a vessel moored at the end of an approximately 1100 meter (m) long pier proposed as part of the Downeast LNG facility along the western shore of Passamaquoddy Bay in the Town of Robbinston, Maine. Engine cooling water would be discharged at 2.8 to 5.6 degrees Celsius (C) (5 to 10 degrees Fahrenheit [F]) above ambient temperatures. The cooling water discharge flow is highly variable based on vessel type. This evaluation used maximum discharge of 7,355 cubic-meters-per-hour, which is approximately equivalent to 2 cubic-meters-per-second (72 cubic-feet-per-second [cfs]), based on 5 representative ship classes.

CORMIX Evaluation

This evaluation was performed using the CORMIX1 subsystem of the CORMIX model to evaluate the geometry and dilution characteristics resulting from a submerged single port discharge. Ambient and discharge data are discussed below. A target temperature differential of 1 degree C was used for the evaluation of results.

Ambient Data

Ambient data for this evaluation was obtained from a variety of sources, including dedicated studies and general assumptions. The depth of water in the project area was determined to be 15 m at Mean Lower Low Water (MLLW), based on bathymetric survey data. This depth was assumed to be constant within the mixing environment. The overall width of Passamaquoddy Bay was determined to be approximately 3200 m, based on navigation charts. It was not known at the initiation of this evaluation whether the analysis should be treated as a bounded or unbounded case. Preliminary analyses suggest that the

30 Park Drive Topsham, Maine 04086 Phone 207-729-1199 Fax 207-729-2715

application of an unbounded geometry is justifiable, however, as the discharge plume geometry is relatively small compared to the overall width of Passamaquoddy Bay and the distance between the end of the proposed pier and the adjacent shoreline (1100 m). Based on this condition, which suggests that potential effects would likely be limited to the near-field environment, it was assumed that the unbounded conditions would provide a reasonable evaluation of discharges from the seaward or landward side of a moored vessel.

It was assumed that the salinity of the discharged cooling water would be equivalent to the ambient salinity of the receiving water body, which is assumed to be 32 parts-per-thousand (ppt). The ambient seawater temperature was assumed to be 18 degrees C (50 degrees F), with a corresponding density of 1024.6 kilograms-per-cubic-meter.

Passamaquoddy Bay experiences semi-diurnal tides with a range of approximately 7 m in the project area. The project area is set back from the main channel, however, and adjacent current velocities are variable and associated with both the primary channel conveyance and eddies. This analysis was therefore performed assuming steady-state conditions with current speeds of 0.05 and 0.5 meters-per-second (m/s). These values were selected as representative of slack tide (e.g., neap tide) and maximum flood/ebb conditions, respectively. While the assumption of steady-state conditions may not be conservative at slack tide, and could therefore affect the discharge plume, it would likely have minimal effects on near-field jet conditions where preliminary analyses suggest that mixing results in temperature differences in excess of 1 degree C.

A wind speed of 2 m/s was used for the evaluations presented here. This is a representative conservative value recommended in the CORMIX documentation. The ambient environment was assumed to be of uniform density (i.e., not stratified).

Discharge Data

The evaluated discharge is approximately 2 cubic-meters-per-second (72 cfs). Preliminary data indicates that the proposed discharge port would be situated approximately 9 m below the water surface, and that the port diameter is approximately 0.76 to 1.0 m. The CORMIX1 subsystem requires that a submerged single port discharge be located within the bottom third of the water column. A discharge depth of 10.05 m (4.95 m above bottom) was therefore used for this evaluation. This requirement likely results in a conservative determination of potential effects on benthic habitat, as the proximity of the discharge to the bottom likely increases the potential for and extent of Coanda attachment.

The discharged engine cooling water was assumed to have a temperature increase of 5.6 degrees C (10 degrees F). The corresponding density of the discharged water is 1023.6 kilograms-per-cubic-meter. A surface heat exchange coefficient of 10 watts-per-square-meter was used, based on recommendations provided in the CORMIX documentation.

Results

A preliminary evaluation of two engine cooling water discharge scenarios was evaluated to provide general insight into potential effects associated with increased temperatures relative to the ambient environment. This evaluation was performed using the CORMIX1 subsystem of the CORMIX model to evaluate the geometry and dilution characteristics resulting from a submerged single port discharge. A target temperature differential of 1 degree C was used for the evaluation of results.

The near-field regions of the evaluated scenarios are characterized by initial jet/plume followed by buoyant rise. Mixing conditions following the buoyant rise and in the far-field region are dependent on ambient current speeds and subsequent mixing in the upper portion of the ambient water column. Figures 1 and 2 are side-view plans along the discharge trajectories for ambient current speeds of 0.05 and 0.5 m/s, respectively. These plots depict the relevant CORMIX analysis modules (e.g., CORJET, MOD110) and the approximate limit of the 1 degree C temperature differential.

Figure 1: Side-View Along Plan Trajectory – Ambient Current Speed of 0.05 m/s

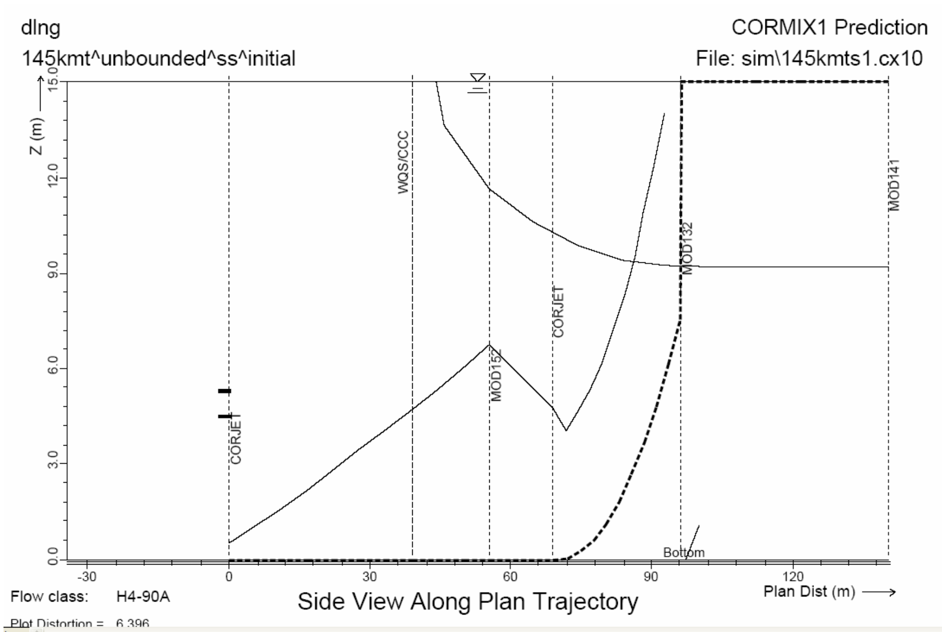
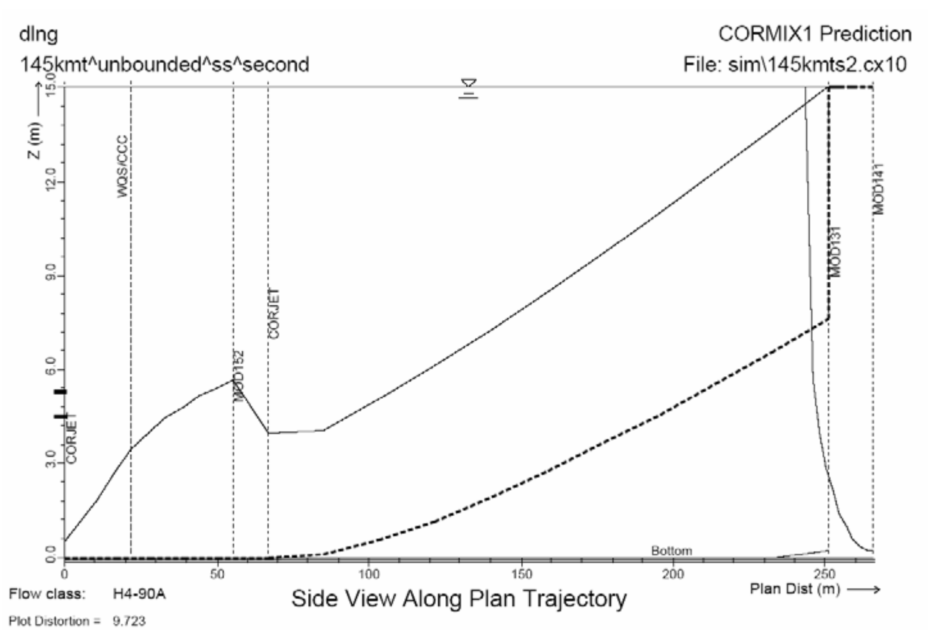


Figure 2: Side-View Along Plan Trajectory – Ambient Current Speed of 0.5 m/s



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The results of this preliminary evaluation indicate that the evaluated effluent discharge will result in temperatures greater than 1 degree C within a relatively small area in the near-field (i.e., the initial jet/plume [CORJET] environment) adjacent to the point of discharge. For both of the evaluated cases (steady-state ambient current speeds of 0.05 and 0.5 m/s), the limit of the 1 degree C temperature rise in the discharge occurs within the initial jet/plume region. For an ambient current speed of 0.05 m/s, this occurred approximately 30 m from the point of discharge. For an ambient current speed of 0.5 m/s, this occurred approximately 15 m from the point of discharge. This area was within the zone of Coanda attachment for both cases.

The potential extents of the areas within the respective zones of attachment were evaluated by post processing of the CORMIX output based on the assumed Gaussion plume cross section, the plume centerline excess temperature, and the 37 percent plume half-width. These areas are shown in Figure 3, and represent the potential areas of bottom subject to temperatures increases in excess of 1 degree C.

Figure 3: Approximate Jet/Plume Attachment to Bottom

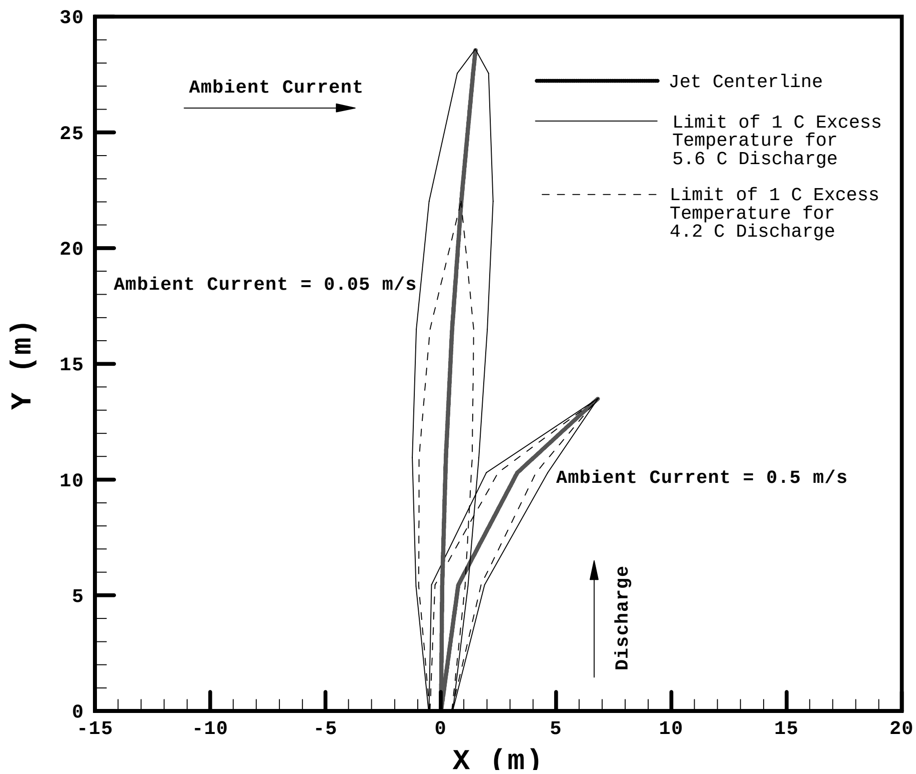

Figure 3 also shows potential areas of bottom subject to temperatures increases in excess of 1 degree C assuming a discharge excess temperature of 4.2 degrees C. This excess temperature represents the average of the anticipated discharge excess temperature range of 2.8 to 5.6 degrees C. Note that these areas were evaluated using the same discharge density as for the 5.6 degrees C, and therefore do not account for a minor decrease in the relative density of the discharged water.

The areas for the regions depicted in Figure 3 are given in Table 1. Because ambient currents vary and are subject to reversal in the project area, the entire potentially effected area would likely be defined by a family of curves defined by the full range of ambient current speeds and symmetrical around the discharge axis (y-axis at x=0) assuming tidal reversal. The total potentially effected area is therefore likely larger than that shown in Figure 3 and Table 1.

Table 1: Potential Benthic Area (m^2) with DT Exceeding 1 degree C

Ambient Current Speed (m/s)	***Discharge DT (°C)***	
	5.6	***4.2***
0.05	68 m^2	40 m^2
0.5	26 m^2	20 m^2